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ELECTRICITY IN JAPAN.

The first portion of Mr. Stuart-Smith's article on "Electricity in the Far East," of which the second installment appears in another column, deals with the very creditable work done in the electrical line in Japan. While it may be a matter of surprise to some to learn that Japan has many competent and even some unusually able electrical engineers, there is no reason why this should not be so. The Japanese have shown that they possess the mental qualifications to successfully prosecute any industry, and the engineering branch of the Tokyo Daigaku is rivalled by few engineering schools in the entire world in its facilities for, and methods of, engineering instruction. It is only recently that Japan has begun to manufacture electrical machinery, but with men to rely upon like Fujioka, Tanabe and several others whose names are known beyond Japan, the result is not doubtful. In one respect the West promises to receive a distinct benefit from the extension of electrical manufactures in the Land of the Rising Sun and the home of decorative art, and that is in the design of fixtures and fittings. With the marvellous artistic instinct and dislike of duplication of designs, characteristic of Japanese in all of their decorative work, we may look forward to creations in this line that will have an important effect on the state of the art here and in Europe, and, as far as electroliers in general are concerned, there is abundant room for improvement in Western countries.

THE NOVAK LAMP DECISION.

Judge Shipman's decision against the Novak lamp followed from the view taken by the court that the manufacturers of the Novak lamp intentionally used the principle of exhaustion to a generous degree, and therefore partially enjoyed the benefits of that part of the Edison combination against which they maintained their claim for a valid patent. The mere introduction of gases into the receiver, the court states, is not important, but, if before they are introduced, the air and residual gases are taken away, and after their introduction the receiver is again exhausted so that a practical vacuum finally remains, though perhaps not as high as thought necessary by Edison for his filament, yet rendering practically stable the filamentary carbon, then the combination of Edison has been infringed, however much the gas used may have improved it, and, notwithstanding, that the Edison lamp itself is not practical with an air exhaustion as low as that used. Waring, according to the court, took the Edison lamp of 1880, which was the first practical incandescent light, and used all of the ideas finally embodied in the Edison lamp, though carrying the idea of exhaustion to a more limited extent than the original inventor thought necessary; nevertheless, without this exhaustion of air and gases his lamp would be a failure. The decision maintains that an inventor of an improvement on a previously patented combination cannot use one of its patented elements in a dwarfed and incomplete way and thereby receive the resultant benefit and escape the charge of infringement by reason of low precentage of such use, and decides against the defendant's theory that its use is so far unlike that of Edison as to be radically different. Judge Shipman's opinion on the other point at issue, that in regard to what date on a British patent shall prevail, adds another authority against the first date on such a patent, and in favor of the date of

affixing the seal, the decision being also against the defendants on this point.

INCANDESCENT LAMP ECONOMY.

In another column Lieut. Eyre takes up the question of the most economical age of incandescent lamps from a purely commercial standpoint and shows very clearly the loss from continuing to use a lamp after a certain period in its life. As very truly remarked, what is wanted is light, and if the light decreases while the current consumed remains stationary or decreases at a less rate than the candle power, it is evident that the cost of a given quantity of light becomes greater as the lamp grows older, until a life is reached when the saving from retaining the old lamp becomes less than the increased cost of power. Or, to put it in another way, the extra cost of the light will finally sum up to an amount exceeding the cost of a new lamp. To continue to use a lamp longer than its most economical life, then, merely consists in saving the cost of a new lamp on the one hand and adding more than the cost of a new one to the meter bill. The curves shown are interesting, as they demonstrate the important fact that, notwithstanding the decrease in the candle power of lamps, the current remains practically the same, and may be even greater than at the start. This is probably due to a change in the character of the filament, such that its surface does not radiate the same amount of light, even if maintained at the same temperature, though the blackening of the lamp bulb has something to do with the decrease in the amount of light. While this subject is worthy, from a financial standpoint, the attention of the small user of lamps, it is doubly important to the large user. One of the factors in the question of economy is the cost of the lamp; the cheaper the lamp the sooner the "smashing" point is arrived at, and consequently the large user, who buys his lamps cheaper, will effect an additional saving by proper attention to renewals.

PROF. FORBES' NIAGARA SCHEME.

As will be seen by reference to the Digest and to the letter of our English correspondent, the paper of Prof. George Forbes on the "Electrical Transmission of Power from Niagara," read before the English Institute of Electrical Engineers, was subject to extraordinarily severe criticism. With scarcely an exception, all of the main features of Prof. Forbes' designs and methods for transmission were condemned, and by men whose opinions are ordinarily given great weight. It cannot escape notice, however, that there was an intense ill-feeling, not disguised in some cases, and apparently entirely due to the alleged methods pursued by the Cataract Construction Company in profiting by unpaid technical information; one speaker even went so far as to say that the undertaking at Niagara would be carried out upon the "unrecompensed work of the entire electrical world." It will doubtless strike the reader that if Prof. Forbes thus had the benefit of the collaboration, though unintended, of the entire electrical world, he was unusually well supplied with data upon which to base correct conclusions, leaving aside the well-known and original ability of the designer himself. The whole matter seems to be that the entire Niagara installation is designed on such radical principles as to be necessarily open to the criticism to which anything may be subjected that departs from existing practice; and that on account of the lack of definite data bearing upon many of the features decided upon, much or all of the criticism may be found without point in the crucial test of practice, while the bitter spirit from which it was evolved doubtless darkened the judgment of many of the critics. Much of the criticism seems to assume that Prof. Forbes adopted the more important features of the transmission scheme upon theoretical considerations alone, while it is known that many were subjected to actual experiment, and none adopted until after a more exhaustive consideration of all points involved than has perhaps ever before been given to any technical undertaking. As far as the Cataract company authorities are concerned, we cannot say that we feel sorry at the rebuff they have thus received as a result of their discrimination in favor of the British electrical public as against our own. We would, however, advise them that when they wish to publish another installment of the information so jealously guarded from Americans, to choose a country in which technical men are not inclined to be so outspoken in their opinions as those of England.

RELATIVE COST OF COPPER FOR CONDUCTORS.

In another column a mathematical discussion of the relative cost of copper for distribution in different electrical systems arrives at conclusions which at first sight may appear singular in some respects. It is shown that if a basis of effective E. M. F. is taken for comparison, the three-phased alternating system requires the same amount of copper as the two-phased system, while there is a saving of 25 per cent. in each of these over the simple alternating system, which is itself in this respect on a parity with the direct current. If, however, the basis of comparison is the stress on the insulation, or, in other words, the maximum E. M. F. in each case, then the direct current requires the least amount of copper to distribute a given amount of energy at a given loss. The three-phased system comes next in economy, but requires 50 per cent. more copper than the direct current system, while simple alternating currents require 100 per cent., and two-phased currents no less than 200 per cent., more copper for conductors under the same conditions as to energy transmitted and $C^2 R$ loss. By reference to the curves in the article it will be seen that the saving noted under the first method of comparison is due to the working currents in the two and three-phased systems overlapping in one conductor thus giving a resultant current in each case, which is less than what the sum of two currents would be if there was no difference in phase. In the two-phased system the decrease in the resultant current is greater than in the three-phased system, the difference in phase being 90 degrees instead of 60 degrees, but the saving thus implied over the former is balanced by the less favorable working disposition of the E. M. F. in the latter system, If the maximum effective E. M. F. in the two-phased system were also the working E. M. F., as in the three-phased system, then the former would show the greater economy. By reference again to the curves shown, it is at once apparent why the direct current is the most favorable as regards the insulation stress or maximum E. M. F., since its effective E. M. F. is also the maximum E. M. F. while in the other three systems this is far from being the case. Here, too, the two-phased system loses in economy for the same reason as given above. That is, if the effective working E. M. F. in each case is 1,000 volts, in the three-phased system this corresponds to the curve of greatest or resultant E. M. F. whose maximum ordinate is 1,414 volts, while in the two-phased system, the corresponding E. M. F., whose maximum ordinate is also 1,414 volts, is that between the two extreme conductors, while the working E. M. F. is that corresponding to the component or primary E. M. F., in relation to which the maximum ordinate is 2,000 volts. While, therefore, by this method of comparison the direct current has the advantage over the alternating current, whether simple or multiphased, and three-phased over two-phased currents, this does not imply much until we approach the limits of insulation stress, whether in conductors or in apparatus, which, it may be added, are scarcely in sight yet. Up to recently our ideas in regard to the consequences of higher voltages were based upon experience with direct currents, in which the con-

siderations were danger to life, and difficulty with commutators, rather than with simple insulation. Owing, however, to the use of transformers with alternating currents, which enable us to almost entirely obviate danger to life from high voltages, the voltage of 10,000 used at the Frankfort-Lauffen transmission was less dangerous in this respect than any arc-light currents under usual conditions. On account of the absence of commutators, the voltage of 10,000 was also produced with less practical difficulties than one-half as great a voltage would be in a direct current machine. The only factor therefore to be ordinarily considered in relation to the voltage of simple or multiphased alternating currents, is the insulation of the line and apparatus, and this factor does not become of direct importance until we approach a practical limit, which seems to be yet far removed. With direct currents, however, we have the two additional factors of danger to life on account of the necessary disposition of the generating and receiving apparatus, and difficulty with commutators, to which may be added a third factor due to electrical difficulties with high voltages at the receiving apparatus, which do not exist where alternating currents are employed with transformers as intermediaries. This is but another illustration of the variance in ideas derived from experience with direct currents and those connected with alternating currents.

Liquid Commutators.

To the Editor of The Electrical World:

Sir.—A description is given by Lieut. F. Jarvis Patten in your issue of Dec. 2 of a "Liquid Commutator" for producing the gradual reversal of electric currents by means of the rotation of a pair of metal plates in a vessel containing conducting liquid, in which two other plates are fixed. Lieut. Patten is evidently not aware that this device has been used for the last eighteen months or more in connection with my "Magnetic Curve-tracer," and is, in fact, the subject of an English patent by Mr. C. G. Lamb and myself, jointly. Commutators of the kind referred to have been described in the London "Electrician," and are made and sold by Messrs. Nalder Brothers, Red Lion street, Clerkenwell, London.

J. A. EWING.

Cambridge University, England, Dec. 27, 1893.

Prof. Forbes' Niagara Scheme.

(From Our Own English Correspondent.)

Rarely in the annals of the Institution of Electrical Engineers has any paper presented to it evoked such a storm of adverse criticism as that aroused by Prof. George Forbes' paper on "The Electrical Transmission of Power from Niagara Falls," and for scarcely veiled personalities, and scarcely suppressed anger, the second evening's debate on Thursday last was unparalleled. Among the speakers in the discussion were Professors Fleming and Silvanus Thompson, Messrs. Mordey, Kapp, Swinburne, Ferranti, Alexander Siemens, Sidney Evershed and Crompton. All these gentlemen were almost unanimous in condemning the low frequency chosen, the method of oil insulation, and the proposed conduit, and, as a minor point, the proposed use of an artificial load for switching alternators into parallel. With regard to the low-frequency, however, Prof. Fleming and Mr. Evershed were in its favor, the former being of opinion that "there was no doubt about the wisdom of selecting this low-frequency at Niagara, where the utilization of power by motors was an important matter, and there were enormous advantages to be gained by the reduction of capacity and other effects by the employment of a reduced frequency," Mr. Evershed pointing out the enormous gain in the reduction of the back electromotive force of induction. Both Mr. Swinburne and Mr. Crompton were anxious to know just exactly what Prof. Forbes expected the difference in cost would be between generating power at Niagara and transmitting it to Buffalo, and generating it *in situ*; Mr. Crompton, moreover, emphazing the general opinion of the meeting, that a narrow conduit containing bare conductors at a potential of 20,000 volts would scarcely be a place for human beings, but expressing the hope that Prof. Forbes did not rely upon ordinary telegraph insulators, even if supplemented by oil, for in his (Mr. Crompton's) experience oil insulators were utterly useless, and insulators which were good enough for telegraphs were not good for underground work. The speech of the debate, however, was that of Mr. Ferranti, who seldom appears at the Institution meetings, and has never before spoken. His criticisms of the technical details of Prof. Forbes' scheme was most unqualified, but he devoted no small portion of the time allotted to him to a vigorous attack upon the methods pursued by the Cataract Construction Company in obtaining its information. The undertaking at Niagara would, he said, be carried out upon the "unrecompensed work of the whole electrical world." The unusual applause which greeted his remarks expressed the feeling of English electrical engineers on this matter. It is needless to say that Prof. Forbes' reply was scarcely less vigorous than the attacks which had been made upon him, his remarks upon Mr. Mordey's speech being specially severe. The speakers on the first evening had, in Prof. Forbes' opinion, only gotten up to show their ignorance and he "felt nothing but sorrow for the position of the Institution in having such speeches made on a matter of so much importance." In spite of all adverse criticism, he felt a great deal fortified in all the conclusions he had arrived at. He denied that the International Commission was a farce, and that those who prepared the schemes had been treated unfairly.

Decision in the Novak Lamp Suit.

On Monday, Jan. 8, Judge Shipman handed down his opinion in the case of the Edison Electric Light Company et al. vs. the Waring Electric Company et al., which was argued at Hartford about a month ago. A temporary injunction was granted.

The decision first defines the Edison lamp in the words of Judge Lacombe, as the combination of carbon, filamentary or thread-like in size and properly carbonized, used as an illuminant, in an incandescent electric lamp, with a receiver made entirely of glass, and conductors passing through the glass, and from which receivers the air is exhausted to such an extent that disintegration of the carbon due to the air-washing action of surrounding gases or to any other cause is so far reduced as to leave the carbon practically stable.

The defendant's lamp, called the Novak lamp, is next defined as the Edison lamp, with the alleged exception that in the receiver a nearly perfect vacuum has not been created by exhaustion of the air, but that into the partially exhausted receiver a portion of bromine gas has been introduced. This introduction of bromine and consequent lessening of the vacuum, it is claimed, produces a marked improvement in the stability of the carbon and diminution of blackening.

After examining the specifications of the defendant's lamp, the courts say that the vague description of the ultimate character of the vacuum and of the amount of "desired" gas which was to be admitted, furnish inadequate data by which to ascertain with precision the extent of the departure from the Edison lamp. The question naturally arises, how much gas is admitted, after the atmospheric air has been exhausted, "as nearly as possible"? The general conclusions, taken by themselves, of Prof. Appleton and also of Prof. Car-

michael, both competent analytical chemists, whose affidavits are introduced by the defendants, would far from satisfy the mind that a material departure from the exhaustion which was the result of the Edison method of manufacture, had been sought in the Waring lamp. Other experts upon each side of this controversy are, however, able to state with more mathematical accuracy the exact nature of the vacuum, and they do not essentially differ in their conclusions.

Referring to the testimony of Profs. Wright and Anthony, the opinion states that they devote themselves substantially to a statement of their opinions in regard to the improved character of the Waring lamp over that of its Edison predecessor, by reason of the introduction of bromine gas, which they think preserves the transparency of the walls of the lamp and the stability of the carbon. While the question of the extent of an alleged improvement upon an existing patented combination may become incidentally important in ascertaining the character of the departure from the peculiarities of the invention which were described in and protected by the patent, it is obvious that the first and vital question is, were all the elements of the patented combination used in the second and improved invention in the manner and to produce the result described in the antecedent patent. Without, therefore, attempting to ascertain the correctness of Prof. Anthony's conclusion that the introduction of bromine into the chamber of an incandescent lamp is a new step in the art, whose results "are of the utmost importance," the court confines itself to a consideration of the question, whether, before he took this step, he made use of the Edison entire combination, and whether the alleged improvement is an addition to and not a substitute for one of Edison's described elements.

As there is no important disagreement between the experts on either side in regard to the vacuum in the lamps of the powers tested, which vary from 1-500 to 1-600 of an atmosphere, the court states that it will confine itself to the results which flowed from those experiments and which it assumes to be true. The defendant's legal position is authoritatively stated in a case cited as follows: "Inventors of a combination cannot suppress subsequent improvements which are substantially different, whether the new improvement consists in a new combination of the same ingredients or of a substitution of some newly discovered ingredient or of some old one performing some new function not known at the date of the letters patent as a proper substitute for the ingredient withdrawn from the combination constituting their invention." Their theory is that the introduction of bromine gas into a globe only partially exhausted is the substitution of a newly discovered ingredient for the air exhaustion of the Edison patent.

What Waring puts into the receiver is not of prime importance, but the question to be solved is whether he exhausts the contents of the globe, whether air, residual gases, or newly introduced bromine gas, to such an extent that when the globe is sealed he has used that part of Edison's combination to such an extent that thereby the carbon is rendered practically stable. The mere introduction of gases into the receiver is not important, but if before they have been introduced Waring takes away the atmospheric air and the residual gases, and, after the new addition has been introduced, he takes away the contents of the globe by exhaustion, so that a practical vacuum finally remains, not as high as Edison thought necessary for the spongy and porous cotton thread which he carbonized, but a vacuum which renders practically stable a carbon, filamentary in size and of whatever hard and dense material it may be composed, then Waring has taken the combination of Edison, however much he may have improved it by the residuum of bromine gas.

To ascertain the effect of the exhaustion by the Waring method upon the stability of the carbon, the court examines in detail the experiments of Prof. Robb, and concludes that in view of the present condition of incandescent lighting in this country, there is no doubt that an Edison lamp with the exhaustion which was given in the experiments would be considered by the users of electric light as so far inferior to the ordinary standard of an Edison lamp as to be worthless, and would be discarded by those who were accustomed to the usual stability of an incandescent lamp. But these experiments show to its mind, when read in connection with the other affidavits of the defendants, that Waring intentionally used the principle of exhaustion to a generous degree and that the vacuum ingredient of Edison was, to a large extent, employed and its benefits were partially enjoyed. Waring took the lamp which Edison gave in 1880 and which was the first practical incandescent electric light, and used all the ideas which were finally embodied in the Edison lamp, but used the idea of exhaustion to a more limited extent than the original inventor thought was necessary; nevertheless, without the large exhaustion of the atmospheric air and the gases which Waring accomplished, his lamp would be a failure. It will not be claimed that the inventor of an improvement upon a previously patented combination can use one of the patented elements in a dwarfed and incomplete way, but by its use receive the old resultant benefit, and escape the charge of infringement by reason of the low percentage of such use. The defendant's theory is that its use is so far unlike that of Edison that it can properly be said to be radically different. That theory is not supported in the Waring specification, and it does not seem to be supported by the facts. The statement in the specification that the atmospheric air may be at first exhausted as nearly as possible and the desired gas then admitted is significant. Profs. Appleton and Carmichael's affidavits show that the amount of gas which finally remains in the globe is small.

The defendant's claim that the Edison patent, which was dated Jan. 27, 1880, has expired by reason of the expiration of the British patent for the same invention, antedated to Nov. 10, 1879, but not sealed, and the specification of which was not enrolled until after the United States patent in suit had been issued, is dismissed, and the motion for preliminary injunction is granted.

Local Meetings of the American Society of Mechanical Engineers.

A series of what may be called local meetings of the American Society of Mechanical Engineers, was inaugurated at the headquarters of the society, 12 West 31st street, on Jan. 10. This new departure, which is of interest to members of the American Institute of Electrical Engineers, in view of the recent discussion among them on a similar subject, was determined upon several months ago when the following resolutions were adopted:

Resolved, That it is the sense of this meeting that it would be desirable and profitable that an opportunity be given for members of the American Society of Mechanical Engineers to meet at convenient times during the coming winter and spring for the discussion of subjects pertaining to mechanical engineering.

It is further resolved that a committee of five be appointed to arrange for such a series of monthly meetings during the coming winter and following spring, that it be authorized to select and appoint a chairman to preside, to fix dates for holding, and to issue calls for such meetings, select subjects for consideration and speakers to present and discuss them, arrange the order of proceedings and make all necessary rules for the conduct of such meetings, solicit subscriptions and audit and pay all bills incurred for such expenses and fill vacancies which may occur during the period named.

In order to avoid misapprehension the committee has deemed it best to explain that the meetings which it is proposed to hold, will not be, in any sense, meetings of the Society, but only of such members as may choose to attend them. The proceedings will form no part of the transactions of the Society, and will not be published by it.

Electricity in the Far East.—II.

BY W. STUART-SMITH.

On each side of the tail race which runs through the centre of the station is to be placed a row of Pelton wheels. As shown in the view of the interior the station is built in steps, being high on both sides and low in the centre. The dynamos are placed well up on the sides, so as to be entirely away from possible danger of getting wet. They are belted from countershafts placed on a step or landing between them and the wheels. Eight-foot Pelton wheels are used, and they are fitted with centrifugal ball governors and deflecting nozzles. At present there are set up two Edison standard 80-kw. 500-volt generators, as shown in the illustration. On the opposite side of the building there is one Thomson-Houston 1,300-light alternating dynamo and one 1,000-light, each being compounded for 15 per cent. drop. Each dynamo is belted from a wheel through a short countershaft. There is no connection between any two countershafts, and consequently each dynamo, with its wheel, is entirely independent of all the rest. The usual bad regulation found in water-power plants exists here, and when any considerable load is thrown off any dynamo it speeds up and the E. M. F. rises. One dynamo supplies at present motors distributed throughout the city, and as the work of these is comparatively steady but little trouble is experienced, but the other machine feeds the 50-h. p. Sprague motor operating the incline cable, and here the bad regulation is very apparent. This motor is not run continually, but is started when boats are to go up or down. When the car with the loaded boat is being hauled out of the water and up the short reverse incline the weight of the cars and boats at both ends of the cable has to be taken and nearly the full horse power of the motor is required; but when the descent of the main incline begins one car is balanced against the other, and only about 5 h. p. is required. This sudden drop

INTERIOR OF KYOTO CANAL POWER HOUSE.

of 45 h. p. is shown in an increased E. M. F. of the dynamo. To compensate this the chief engineer of the station has had extra rheostats made for each dynamo. They are placed in series with the rheostats furnished with the dynamos, and by means of them a very large resistance can be thrown into the field. When the 50-h. p. motor is to be started the attendants are notified by means of a call bell from the motor house and one of them takes his stand at the rheostats and watching his voltmeter throws in or out his resistance as required.

The writer strongly advised them to arrange the short countershafts so that they could be connected together by clutches, or to use one long countershaft on each side and have the wheels and dynamos belted to clutch pulleys; then if the load of any one dynamo was suddenly varied the change of load would be divided between all the wheels and the effect on the speed would be scarcely noticeable. Ten wheels having an aggregate horse power of 1,200 would be belted to each shaft, and the change of load would have to be very considerable to have an appreciable effect.

With about 2,000 h. p. of distributed motors, which it is expected will be connected with the circuits leading from

DISTINCTLY JAPANESE.

each side of the station, the wheels will be constantly running at nearly their full power.

The two dynamos shown were set up, circuits to the city run, and everything ready for the delivery of current to factories in July, 1891. A 5-h. p. Sprague motor was installed in a clock factory almost as soon as the circuits were run. This gave perfect satisfaction, as the writer found by visiting the factory, but with the exception of the 50-h. p. incline motor no other was installed for about a year. Then a 30-h. p. Edison machine was put in a cotton mill, and in spite of exceedingly bad treatment gave such good satisfaction that during the next year quite a number were installed.

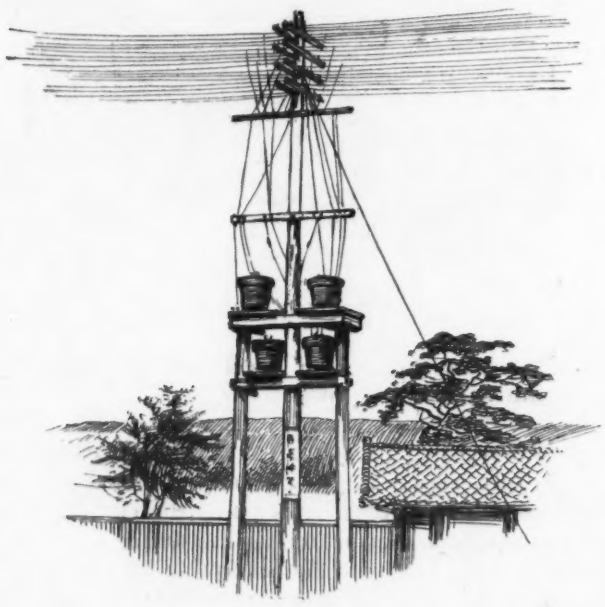
The writer at the time was in charge of the Edison electrical work in Japan, and it having been reported to him that the canal company's engineer had told the mill people not to run the motor up to its rated power, he wrote to know the reason and received a letter, of which the following is an extract: "You wrote me about the Fujii mill motor, that I told the mill people not to put more than 48 amperes on it. Why! there must be some mistake in it, as I never told such a thing to the mill people. But the people there, or rather the workmen, are very careless fellows. They sometimes caught a rat alive, with which they short-circuited and killed it, and at the same time fused the fuse wire. Sometimes they melted wire by crossing two terminals of the double pole key and at the same time melted the key. Sometimes they put on more load than they should do, and I think they do it just for fun; so I told them positively they must not put on an overload."

This motor proved to be too small for the mill, and it has since been replaced by a 45-h. p. Thomson-Houston.

In June of this year the following motors were in operation: 50-h. p. Sprague, running incline cable; 5-h. p. Sprague in clock factory; 10-h. p. Sprague in brass plate mill; 15-h. p. Sprague in Electric Light Company's station for running a Brush arc machine (this machine has a capacity for 45 1,200-c. p. lamps, but only twenty were running in June); 45-h. p. Thomson-Houston in cotton mill; 6-kw. Edison in repair shop of fabric mill; 1 1-2-h. p. Thomson-Houston in clock factory; 1-h. p. Perret in aerated water manufactory. Of all these motors the Perret was held in highest repute. The canal company has quite a number of motors in stock, and without doubt several have been installed since the writer's last visit, about the first of last June. The mills and factories in which these motors are installed are lighted by ordinary 16-c. p. lamps, placed five in series. The motor farthest from the station is the 1-h. p. Perret, about two miles distant; the 45 h. p. is about one mile.

In 1895 an industrial exhibition is to be held in Kyoto and all machinery will be run by electricity.

The Kyoto Electric Light Company was started before the canal company was ready for business, and the city authorities agreed that the canal company should devote itself to power distribution and not interfere with the lighting business. The lighting company started with four Edison dynamos on the three-wire system, and had been running some time before the canal company was ready to deliver



TRANSFORMERS IN STREETS OF TOKYO.

power. Then an agreement was entered into, in virtue of which the canal company has set up the two Thomson-Houston alternating dynamos above mentioned. These are regulated for a drop of 15 per cent., and send current to the lighting company's station, from whence it is distributed by that company. This arrangement was made in order to utilize some of the surplus power of the canal company's station, but when this power is needed for mill purposes the lighting company will go back to the use of steam engines.

In addition to the 2,400 h. p. available on the Pelton wheels in the main station, about 600 h. p. more can be obtained from the Kamogawa as it passes through the city. In five places there are locks, the extreme ones being about one mile apart, and at each of these 120 h. p. can be obtained on a low head turbine. When the main station is loaded to its capacity this extra power will be developed and added to the other. On the basis of divided power, it is expected that more than 4,000 h. p. of motors can be installed, with an average price of not less than 100 yen per h. p. per year.

Considering the magnitude of the preliminary work and the importance of the result to be obtained, and the fact that all this has been done by the Japanese, a people who twenty-five years ago had scarcely an idea of Western civilization, it must be agreed that the plant is a most interesting one.

The two 500-volt generators and several motors had been delivered to the canal company several months before they were ready to install them; finally everything was ready for work when word was received at the office of the Edison agents in Yokohama that both generators and all the motors were grounded on the fields and armatures. The writer at once proceeded to Kyoto to investigate and found that a magneto would ring through all fields and all armatures as stated. It was out of the question that the grounds existed as the Japanese engineer thought, and a little investigation showed the trouble to be due to a film of moisture over the insulation. It was very hot weather, and as the water stood in and about the station the buildings were filled with moisture and the machines sweated considerably. The engineer was considerably frightened upon starting the machines, feeling sure they would burn out, but being guaranteed against damages they were started and no further trouble experienced.

The two power generators and all the Sprague, Perret and Edison motors were supplied to the canal company by Messrs. Frazar & Co., of Yokohama (Mr. Everett Frazar, 69 Wall street, New York), who were sole agents in Japan for the Edison company from the beginning of that company until some time after the formation of the General Electric Company. They were the pioneers in establishing electric lighting in Japan, the plant in the Mikado's palace being one of the first in the country. For several years they supplied nearly all the electric machinery used in Japan, more than one hundred dynamos and motors having been introduced by them. The business which they built up grew to such dimensions that other American and European companies have established agencies there, and the Japanese have begun to manufacture, so that competition is now very keen.

The first lighting plant of importance was the Imperial palace plant, started about 1888. It was installed and for some time managed by Mr. Brenner, lately with the Edison company in Toronto, Canada. After a time it was placed under the management of the Japanese engineers, and became the first section of the Tokyo Electric Light Company. This company has grown until it now has five stations located in different parts of Tokyo, from which are running perhaps twenty thousand lamps. The lines from all the stations form a network on the three-wire system. Most of the machines are from the Edison factory, though recently two or three alternating dynamos have been put in. Brush arc lamps are used for street lighting in some places. The number of lamps installed is being rapidly increased. For a long time the company was heavily in debt, but last year a dividend was declared, and now its standing is good.

The chief engineer is Mr. I. Fujioka, a man of international reputation. He is head and shoulders above all other Japanese electricians in his knowledge of electrical matters and is a lecturer in the Engineering College of the Imperial University. He is especially desirous of manufacturing steam and electrical machinery for all purposes, and is chief engineer and a large stockholder in the Miyoshi Dento Kojo (the Miyoshi Electric Manufacturing Company). This company make Armington & Sims engines and Edison 125-volt dynamos. These machines are of good quality, and many of them are running in various parts of Japan. Mr. Fujioka is also anxious to export them to other parts of the Orient, and will no doubt succeed in placing them in China and Korea. Everything connected with the Edison lighting system is manufactured, such as Howell pressure indicators, comparative indicators, ampere meters, lamp sockets, elec-

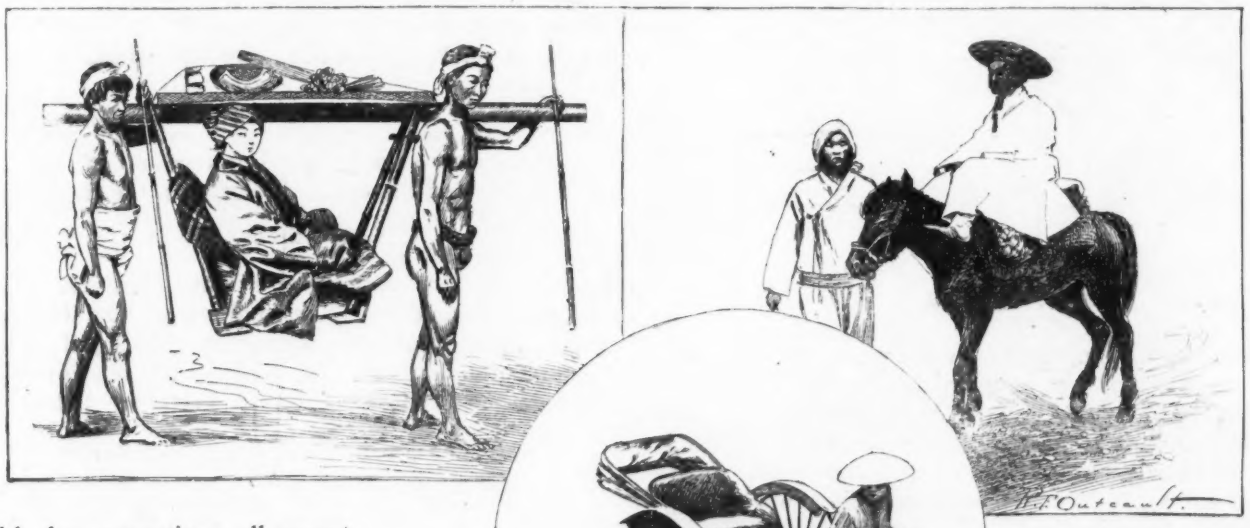
troliers and fittings of all sorts. A year ago about 1,000 lamps per week were made and the number was constantly increasing. The life is quite satisfactory, the average being over 600 hours. They retail for 50 yen each and yield a good profit. When the quality is somewhat improved and the manufacturing facilities increased the company is ambitious to send them to compete for the American market. It is certain that the sale of foreign lamps will soon become very small unless the price can be made very cheap.

The company endeavors to sell as near the price of imported dynamos and engines as possible, but in case of necessity they are able to quote a price that is far below what a foreign machine can be sold for. It is through Mr. Fujioka's high engineering abilities that the success of these machines has become assured. He is also making Brush alternators, Thomson-Houston converters, etc., and will soon be turning out 500-volt generators for power purposes, as well as mining machinery of all classes. Great difficulty will, however, be experienced with machines requiring high insulation, such as arc machines, alternators and converters, as the Japanese are not accustomed to the high grade of work required. They are, however, rapidly learning. The Miyoshi company claim to be able to make converters equal to the imported ones, but the best answer to this claim is the fact that on the lines of the Tokyo Electric Light Company Mr. Fujioka is putting up the foreign made article.

In addition to the five stations of the Tokyo Electric Light Company there is a station supplying about 1,000 lamps on the Thomson-Houston system, one supplying about the same number on the Westinghouse system and perhaps two or three thousand lamps from English dynamos.

The next largest lighting station is in Osaka, where the Thomson-Houston system is exclusively used. About ten thousand lamps are connected, all from one station. The Osaka company have been sole Thomson-Houston agents for some years, and are now sole agents for the General Electric Company. They are considerable manufacturers of sockets, electroliers and general fittings, though this work is not done under their name and they deny any connection with it, their agreement with the General Electric Company not permitting them to make any use of native-made goods. In addition to this central station there are many plants in mills and factories, most of which are Edison.

(To be continued.)



A FIELD FOR ELECTRICITY.

With few exceptions all recent plants and extensions are supplied with fittings of Japanese make, as they are cheaper than the foreign article. Large quantities of Japanese-made wire is also used, especially for street work. The Parliament building at Tokyo was wired and fitted with material of Japanese-make, and about three years ago it was burned, the fire being due to defective material. Since then the government has refused to allow any native-made material or fittings to be used in public buildings, and rigid inspection is made to see that everything is first class. Recently the government buildings have been fitted with Interior Conduit tubing, and this will probably be required in future work.

Two years ago Kanda, a district in Tokyo, was swept by a fire and four thousand houses destroyed, and among the others was the Kanda station of the Tokyo Electric Light Company. The fire was caused by the carelessness of a waiter in a restaurant, and as punishment for the first offense of 4,000 houses he was fined 15 yen and told not to "do so some more."

Electricity and Windmills.

The Netherlands Society for the Promotion of Industry offer a gold medal and £30 for the best paper on the production of electricity by windmils, its storage, transmission, and utilization. The following points in particular should be attended to: 1. What is the average energy a common windmill is able to produce per day of twenty-four hours in combination with an electric accumulator; what would be the installation most suitable to this effect, and what would be the cost of one horse-power hour? 2. Is it possible, from an economical point of view, to apply the new aerial motors on an extensive scale for the accumulation and the utilization of this energy? If so, what mechanical appliances would be required for this purpose? The project of a supposed application of the system, by which a factory is provided with light and power, is wanted as an illustration. Answers must be sent before July 1, 1894, with the author's name, in a closed envelope, to the general secretary of the society, F. W. Van Eeden, at Haarlem, Holland.

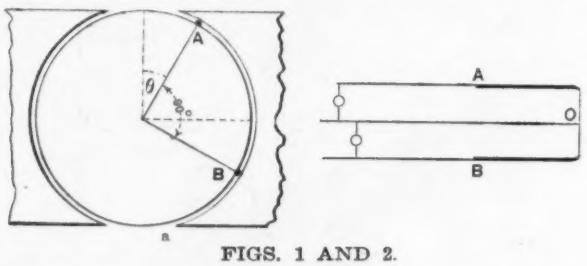
This problem is a most interesting one, and no doubt will be taken up by American inventors. The utilization of wind power for the generation of electricity has long been striven for, but thus far with no great commercial success.

Relative Costs of Distribution by Different Electrical Systems With the Same Effective or Maximum E. M. F.

By W. D. WEAVER.

THE saving in copper over the simple alternating system in the two- and three-phased systems still being a matter of dispute, the following is offered as an attempt, starting from first principles in each case, to determine if the problem, if it so may be called, does not admit of a perfectly definite solution. In the first part of the article, the comparisons will be made on the basis of effective E. M. F., and in the second part on the basis of insulation stress or maximum E. M. F. Mr. Gisbert Kapp, in an able paper read before the last meeting of the British Association for the Advancement of Science, brought forward, for the first time it seems, the latter method of comparison, but without giving any clue to the manner in which he arrived at the results stated.

Fig. 1 represents diagramatically a two-phased generator, and *B* being sections of the armature wires, the other extremities of which are joined and led to a third collecting ring. Fig. 2 represents a two-phased system developed, the heavy lines designating the armature wires or the seat of the



FIGS. 1 AND 2.

E. M. F. To simplify matters, we will assume the junction of the two armature wires to be maintained at zero potential.

Then, the rate at which *A* and *B* are cutting lines of force are sin θ and sin $(\theta+90°)$ respectively, or the E. M. F. at any instant between *A* and *O*, *B* and *O* and *A* and *B* is sin θ, cos θ and $(\sin\theta+\cos\theta)$ respectively, neglecting constants, while the effective E. M. Fs. are

$$\left(\frac{1}{2\pi}\int_0^{2\pi}\sin^2\theta\,d\theta\right)^{1/2},\ \left(\frac{1}{2\pi}\int_0^{2\pi}\cos^2\theta\,d\theta\right)^{1/2}\text{ and}$$

$$\left(\frac{1}{2\pi}\int_0^{2\pi}(\sin\theta+\cos\theta)^2\right)^{1/2} \qquad (1)$$

or $\frac{\sqrt{2}}{2}$, $\frac{\sqrt{2}}{2}$ and 1; that is, the E. M. F. between the extreme wires is $\sqrt{2}$ times greater than that between either leading wire and what may be called the common return.

Assuming that the entire resistance in each of the two circuits is unity, the currents flowing at the same instant in the three wires (Fig. 2) have the values sin θ, cos θ and $(\sin\theta+\cos\theta)$ and the effective currents are, therefore, also respectively $\frac{\sqrt{2}}{2}$, $\frac{\sqrt{2}}{2}$ and 1; that is, the current in the common wire is $\sqrt{2}$ times greater than the current in either of the other two wires.

Fig. 3 represents diagramatically a three-phased generator with a "star" winding, *a*, *b* and *c* being sections of the armature wires, which are supposed to be joined at the other end of the armature. Assuming that the point of union is maintained at zero potential, then the rate at which each wire is cutting lines of force, and therefore the potential at the end of each wire on open circuit, is, at $a = \sin\theta$; at $b = \sin(120°+\theta) = \sin(60°-\theta)$; at $c = \sin(240°+\theta) = -\sin(60°+\theta)$, from which it follows that the poles of a three-phased motor differ by 60° in phase. This might have been foreseen, for by drawing the lines *O M* and *O N*, it is evident that wires at *M* and *N* would cut lines of force at the same rate as the wires *c* and *b*.

Connecting the points *a*, *b* and *c* (Fig. 4), the difference of potential at any instant between *a*–*b*, *b*–*a* and *b*–*c* are respectively

$$A = \sin\theta+\sin(60°+\theta);\quad B = \sin(60°-\theta)-\sin\theta;$$
$$C = \sin(60°-\theta)+\sin(60°+\theta). \qquad (3)$$

from which it follows that the sum of the three E. M. Fs. at any instant is zero, and that the sum of two E. M. Fs. is always equal to the third.

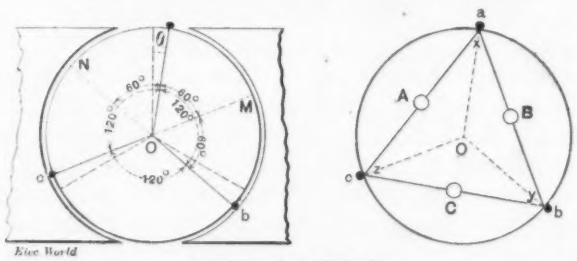
The effective E. M. F.'s are:

$$A_{\text{eff}} = \left(\frac{1}{2\pi}\int_0^{2\pi}\left((\sin\theta+\sin(60°+\theta)\right)^2 d\theta\right) = \sqrt{\frac{3}{2}} \qquad (4)$$

$$B_{\text{eff}} = \left(\frac{1}{2\pi}\int_0^{2\pi}\left((\sin(60°-\theta)-\sin\theta)\right)^2 d\theta\right)^{1/2} = \sqrt{\frac{3}{2}} \qquad (5)$$

$$C_{\text{eff}} = \left(\frac{1}{2\pi}\int_0^{2\pi}\left((\sin(60°-\theta)+\sin(60+\theta)\right)\right)^2 d\theta\right)^{1/2} = \sqrt{\frac{3}{2}} \qquad (6)$$

As the E. M. F. generated in any one winding, as in *a*, is $\frac{1}{2\pi}\int_0^{2\pi}\sin^2\theta\,d\theta = \frac{\sqrt{2}}{2}$, (7) if to the windings of a 1,000 volt alternator two similar windings are added and so arranged to develop three-phased currents, the E. M. F. will be raised $\sqrt{\frac{3}{2}}\Big/\frac{\sqrt{2}}{2} = \sqrt{3}$ times, or to 1,732 volts, instead of 3 times or to 3,000 volts if the additional windings were superimposed on the original ones. Or, if the armatures of three 1,000-volt alternators are rigidly coupled with corresponding coils advanced with relation to each other one-third of the distance between poles, three-



FIGS. 3 AND 4.

phased currents will be generated with E. M. Fs. of 1,732 volts. It will also be seen, referring to Figs. 3 and 4, that if the point where the three wires are joined is united to a fourth collecting ring, the difference of potential between the fourth wire and any one of the other three will be $(\sin\theta - 0)$, $\sin(120°+\theta-0)$, etc., or the effective E. M. F. will be $\sqrt{\frac{1}{2}}$ instead of $\sqrt{\frac{3}{2}}$; that is a three-phased generator may have six circuits with four conductors, three with an E. M. F. of say 1,000 volts, and three with an E. M. F. of 1,732 volts in that case.

Su ppose, now, that the currents flowing in the windings *a*, *b* and *c*, or, which is the same thing, in the three wires o the line, are *x*, *y* and *z*, and that the resistance in each branch, *A*, *B* and C (Fig. 4), is unity; then, if the currents in the branches at any instant are *A*, *B* and *C*, those in the three legs of the line will be, from (3)

$$x = A - B = 3\sin\theta \qquad (8)$$

$$y = B + C = \frac{3\sqrt{3}\cos\theta}{2} - \frac{3\sin\theta}{2} \qquad (9)$$

$$z = A + C = \frac{3\sqrt{3}\cos\theta}{2} + \frac{3\sin\theta}{2} \qquad (10)$$

Integrating for the effective currents, we find these to be $\frac{3}{\sqrt{2}}$ in each case. But since the resistance in the branches is unity the currents there are $\sqrt{\frac{3}{2}}$, and, therefore, the current in each leg is $\frac{3}{\sqrt{2}} \Big/ \sqrt{\frac{3}{2}} = \sqrt{3}$ times greater.

We can now make a comparison on the basis of effective E. M, Fs. required in distribution for the same C^2 R loss. Suppose the voltage to be the same in each case, that each lamp take one ampere and that the resistance of each lead is one ohm. Figs. 5, 6 and 7 represent simple alternating, two and three-phased circuits, each having six lamps of the same voltage, the currents flowing in each lead being as deduced above. The loss

in Fig. 5, is $(6)^2 \times 2 = 72$ watts;

in Fig. 6, $(3)^2 \times 1 + (3\sqrt{2})^2 \times 1 + (3)^2 \times 1 = 36$ watts;

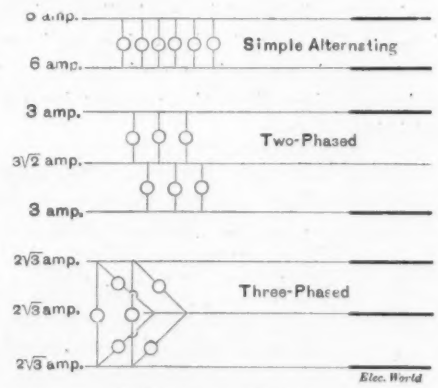
in Fig. 7, $(2\sqrt{3})^2 \times 1 + (2\sqrt{3})^2 \times 1 + (2\sqrt{3})^2 \times 1 = 36$ watts.

Now, if in Fig. 5 we were to add another wire of one ohm resistance to each side, the C^2R loss would be halved, or become 36, the same as in the other cases, and we have the following comparison:

	Work.	C R loss.	Wires.	Saving.
Simple alternating	6 lamps	36 watts.	4	
Two-phased	6 "	36 "	3	25 per cent.
Three-phased	6 "	36 "	3	25 per cent.

or, on a basis of effective E. M. Fs., with the two and three-phased systems there is a saving in copper for conductors of 25 per cent. over the simple alternating system in each case, but no saving in the three-phased system over the two-phased.

With alternating systems, however, the stress to which insulation is subjected is not a function of the effective, but of the maximum E. M. F.

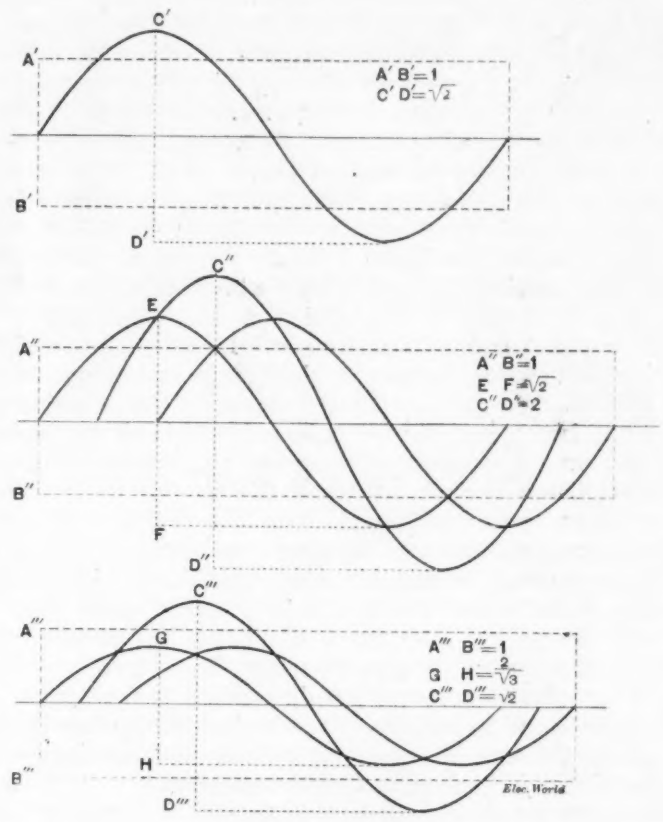


FIGS. 5, 6 AND 7.

From (7) we see that in the simple alternating system, if the maximum E. M. F. is unity, the effective E. M. F. is $\frac{\sqrt{2}}{2}$, from which it follows conversely that if the effective E. M. F. is unity the maximum is $\sqrt{2}$.

Similarly, in a two-phased system what may be called the working maximum E. M. F. is also $\sqrt{2}$ when the effective E. M. F. is unity, but from (1) we see that the difference of potential between the two outside leads is $1 \Big/ \frac{\sqrt{2}}{2} = \sqrt{2}$ times this, or the maximum stress in this system for an effective E. M. F. equal to unity is $\sqrt{2} \times \sqrt{2} = 2$.

In the preceding calculations for the three-phased system, we assumed the maximum E. M. F. in any one of the armature wires to be unity, but as the E. M. F. between the working leads was shown to be $\sqrt{3}$ times this, the maximum E. M. F. of the system is $\sqrt{3}$, which corresponds to the effective E. M. F. of $\sqrt{\frac{3}{2}}$ calculated; therefore, reduced



FIGS. 8, 9 AND 10.

to an effective E. M. F. of unity the maximum E. M. F. is $\sqrt{3} \Big/ \sqrt{\frac{3}{2}} = \sqrt{2}$. In Figs. 8, 9 and 10 curves are plotted showing the relation between the various E. M. Fs., in which A B in each case represents the effective E. M. F., or that of the direct current used for comparison.

For an effective voltage, therefore, of unity in the simple alternating, two and three-phased systems, the stresses on insulation are as $\sqrt{2}$, 2 and $\sqrt{2}$ respectively, or that much greater than for a direct current of the same voltage, and it follows that if the stress is to be the same as with the direct current, the effective voltage must be reduced in proportion to $\frac{1}{\sqrt{2}}$, 2 and $\frac{2}{\sqrt{2}}$ respectively. If, now, the machines are to do the same work, the currents will have to be increased in the same proportion as the voltages are reduced, and consequently the C^2R losses will become $(1)^2$, $(\sqrt{2})^2$, $(2)^2$ and $(\sqrt{2})^2$ for the direct, simple alternating, two- and three-phased systems respectively, or as 1 : 2 : 4 : 2. But we have shown that for an equal output there is an intrinsic saving of copper of 25 per cent. in the two and three-phased systems over the simple alternating system, and, therefore, also over the direct current system, so that the ratio become 1 : 2 : 3 : 1.5, or as 100 : 200 : 300 : 150.

That is, for the same stress on the insulation, and for the same output in watts, for each 100 pounds of copper required for distribution with direct currents, 200 pounds will be required with simple alternating currents, 300 pounds with two-phased currents and 150 pounds with three-phased currents. These numbers are the same as those given by Kapp, except that for the two-phased system, which in his paper is 290 instead of 300, as here deduced.

Problems for Inventors in Incandescent Lighting.

BY DR. L. K. BOHM.

NOTWITHSTANDING the fact that numerous improvements in incandescent lighting have been patented since the invention of the commercial lamp in 1879, yet there is a vast field for inventors in this line. Quite recently experimenters have taken up the subject again with renewed vigor, since Edison's fundamental patent of Jan. 27, 1880, was sustained by the Circuit Court of Appeals on Oct. 4, 1892. As a consequence of this decision, a number of lamp manufacturing companies closed their factories by order of the Court, and as they possessed the facilities for the manufacture of lamps they were certainly very anxious to adopt new lamps which would at least stand a fair fighting chance in the courts, if they were not entirely independent. Inventors saw a rich harvest before them, because it might not be saying too much, to express the opinion that the rights of the proprietors of the Edison patent will finally be enforced in all the States. Of late even a competitive company, the Waring Electric Company, has conceded that the Edison patent is valid. There is no doubt that the majority of inventors are rejoicing when patents are sustained by the courts, because inventions will then prove of greater value and capitalists will have confidence in inventions and money be procured easily by deserving inventors. It is no more than a logical fact that patents be sustained, because the patent laws of this country have been the chief factors for developing the resources of the country and have built up new and profitable industries. A patent, if sustained, is a contract between the government and a private individual, and there is no earthly reason why such a contract should not hold in the courts just as well as a contract between two private individuals. However, in patent law suits, opinions may differ regarding the scope or range of an invention and how claims are to be interpreted, that is, how far reaching or limited they shall be.

Experimenters in incandescent lighting may at the present moment be divided into two classes. Some try to improve upon the Edison lamp and others desire to invent lamps which do not infringe on any patent. The first mentioned may invent better filaments or they may look for lamps which can be manufactured cheaper.

The second class of inventors in this line must look for separable lamps, which consist of two or more parts, because the Edison patent covers in plain words an all glass closed chamber united by the fusion of the glass. Lamps which have two parts, made of other material than glass, for instance, of metals, alloys, cement, etc., are independent, according to the above; if they consist, however, entirely of glass they must be separable and not united by fusion of the glass.

The greatest chance for improvement is and will be in the future in the filaments. Inventions in this line will be of great value even after the Edison patent has expired. It is a well-known fact that the higher the voltage the larger will be the number of lamps which a lighting plant can carry with the same amount of copper in the ground. An installation with 220-volt lamps would carry theoretically twice the number of lamps that it carries at present with 110-volt lamps, and these lamps would not involve a change in the central station wherever the three wire system is in use. Filaments of more than 120 volts can be made of carbon by simply increasing their length, and this has been done by some concerns; for instance, the de Khotinsky company in Germany made filaments of 150 volts. Several disadvantages were experienced in shipping and operating these lamps; too long filaments break off easily when shipped where they are cemented to the platinum wires. In practical operation these lamps sometimes show illuminated gases upon the cement, and when the volume of the gas increases it may happen that some of the current is passing from one little bulb of cement through the illuminated gases to the other little bulb of cement, thus causing the fusion of the platinum wires. Before the platinum fuses and while there is a short circuit between the little bulbs of cement, the filament is heated up but certainly not to full candle power. This phenomenon may easily be explained. The high-voltage carbon has a correspondingly high resistance, and the resistance between the little bulbs of cement is decreasing when more gases emanate from the cement. As soon as the resistance has been reduced enough the current will pass through both the filament and this space in accordance with their respective resistances. To remedy these defects high resistance filaments should never be fastened to the ends of the platinum wires by putting cement on; they should be fastened by electrolytically depositing carbon on there, because carbon deposited this way is very hard and does not give much gas. The two legs of a high resistance filament should be as far apart as practically possible for inserting it into the lamps and the vacuum should be as high as possible.

To avoid the exceptionally large breakage in shipping high resistance filaments should not be longer than 110-volt filaments. This may be accomplished by introducing into the filament mass substances of higher resistance than carbon or any known conductor of electricity. Such masses may be made of metal powder and metal oxides or of carbon mixed with metal oxides or suitable elementary substances. Magnesium and calcium oxides in carbon filaments have been patented. (U. S. Patent to L. K. Bohm, Dec. 8, 1891.) Other filaments were treated in atmospheres containing gaseous compounds; for instance, of silicium, chromium, phosphorus and iron. (U. S. Patents to Heller & Erlewein, 1891.) These filaments had a mineral coating on the surface of the carbon. However, for one reason or another, these lamps have never replaced the carbon filament lamp. There is still in this direction a great field for inventors. Some experimenter may discover a composition which is a sufficient conductor of electricity and allows the manufacture of high-resistance filaments for incandescent lamps, which do not volatize so much as carbon and maintain their candle power for a longer time than the present lamps, even when burned at a higher economy.

If such compositions for filaments are discovered which will give incandescents of greater durability, then they certainly can be made of higher efficiency, say of at least 2 1-2 watts per candle. The advantages of economical lamps were fully described by me in The Electrical World of Feb. 4, 1893, and need not be repeated here.

The shape of the filament may also be greatly improved. It is rather remarkable that nothing has been done in this direction with a view to improve the effect of the light. The original horseshoe form is still used to the greatest extent, and the coiled filament, as made first by Swan, was made in this shape for the purpose of shortening the filament, and up to the present day only 110-volt filaments are made in this form. The 50-volt filaments are in horseshoe form. Those using incandescent lamps needing the light close to their work often complain that the light shows a peculiar line on the table or paper resembling the form of the horseshoe. This is disturbing, especially for writing, reading, jewelry work, watchmaking and the like. In large rooms and halls where many lamps are burning and where they are high up these lines are not observed. Experiments should be made with various shapes of filaments in order to find out what shape will remedy this deficiency.

(To be continued.)

A New Method of Preventing Heat Radiation.

BY R. A. FESSENDEN.

THE use of electricity for heating has lagged somewhat behind its application for lighting and power. In spite of the fact that its use has met with most signal success in some special processes, such as electrical welding and forging, its employment in this way is very restricted.

One reason of this is the application of electricity to produce heat in ways for which it is not fitted. The use of electricity is economical only when the heat is to be localized and guarded from losses, and where temperature rather than quantity of heat is sought for.

The use of electrical resistance for heating street cars can, for instance, hardly be conceived of as economical under any circumstances, for if a company has power in excess of that required to run street cars, it would certainly make money by using coal in the cars and selling the extra power at as low a price as two cents per kilowatt hour, at which rate it could hardly fail to obtain customers.

A second reason is the difficulty in checking radiation from the body heated. According to the results obtained by Macfarlane, the amount of energy radiated from a box of metal raised to a temperature of 200 degrees C. above the air is equal to about 40 h. p. The writer's experiments make it about a third of this, or about 15 h. p. (The probable cause of the difference is given below.)

If we take the price of one kilowatt hour as fifteen cents, it is seen that the energy spent in merely maintaining the temperature of the box will cost about $2.25.

If the box is surrounded with a covering of asbestos one inch thick, the loss from radiation will only be reduced one-half, and the expense of keeping up the temperature of the box will be about $1.12, still much too high to be economical, except in extreme cases.

If, however, we confine our applications of electricity for heating to cases where temperature is required rather than quantity of heat, and if we can succeed in keeping down the radiation and convection losses, there are a very great number of cases where we may use electricity with economy and advantage.

One of these is, of course, electrical cooking. At present, owing to the inefficient means of checking radiation, the expense is too great for its practical use, except in special cases. As an instance it may be mentioned that a small oven on exhibition at the World's Fair this summer (and which was nicely blackened outside so as to radiate the greatest amount of energy possible), consumed no less than 3.83 h. p., which figure would probably rise to 4 h. p. in colder weather; the cubic contents of the oven being only 2.6 feet and the surface exposed to radiation only 11.5 square feet. At the rate of 11 cents per horse power hour this would mean an expense of 44 cents per hour.

The calculated loss from radiation in this case is about 3 h. p., and is probably something over that. The advantage to be gained in reducing the radiation is very evident.

Another typical case is the manufacture of varnishes. In 1890 the writer, while working at this subject from the chemical side, was led to the conclusion that the reason why varnishes could not be made colorless except by using the more expensive kinds of gum was because the melting point of the gum was so near the decomposition point of some of its constituents that the two actions always went on together, the result being a blackened varnish. It immediately suggested itself that this must always occur when charcoal or other fuel is used to melt the gum, as the sides of the copper kettle must always be hotter than the gum in the centre, otherwise there would be no flux of heat, and that unless an inordinate time be taken, this heat gradient must always be so steep that the gum at the sides of the kettle must be decomposed before the gum in the centre is melted.

An obvious solution was to perform the work by electricity, and a number of experiments were carried out, with the most complete success, varnish being made from inferior and cheap gums which surpassed that made from the most expensive kinds in the market. The method used was to place the vessel containing the gum in a large box, heated by a coil of iron wire. The temperature was governed by an automatic regulator, and the hot air penetrated through the pieces of material to be melted so that the melting commenced evenly, and was finished much sooner than usual, and there was an almost absolute absence of black products of decomposition.

While the experiments demonstrated the complete success of the process as regards the making of varnish from inferior gums, the gain in this way was so nearly offset by the loss through the increased expense, due to the use of electricity, that the process was never worked on a large scale. With improved means of preventing radiation, however, there is little doubt that it would prove a success.

A third type may be illustrated by the manufacture of sulphuric acid. To concentrate this there are at present two methods in use. (A third method, that of letting the dilute acid trickle over heated stoneware, is only suitable for the manufacture of commercial acid, and would not do where the chemically pure acid is required.) The first is the distillation of the water from the acid, while contained in glass vessels heated externally. This method is expensive on account of the great amount of breakage of the glass vessels, the least draught of air sufficing to crack them.

The second method is hardly less expensive, as it involves the use of large platinum stills. The first cost and the interest on these is very high; moreover, they do not last, as the sulphuric acid acts on them, slowly but surely dissolving the platinum.

It is very easy to devise a method of performing this process by the use of electricity, the acid being contained in shallow glass vessels and surrounded by a lead chamber, so arranged that there can be no drip back into the glass vessels. Here again, however, experiment showed that the losses through radiation were too great to make the process pay.

We see, therefore, that in the three cases where temperature rather than quantity of heat is required—where an even distribution of temperature is necessary—and where the application of heat requires expensive vessels, that the use of electricity is indicated, and would be commercially profitable were it not for the great losses from radiation. It is the object of this note to describe a simple method by which such losses can be greatly reduced.

In 1892, the writer, while considering the question, conceived that the principles pointed out by Fourier ("Theory of Heat," Sec. 88, Freeman's translation), might be practically applied. Though the proof was not free from inexactness, it was thought worth while to give the method suggested by the equations a trial. The subject was given to two of my senior students, Messrs. Keiper and Fisher, by whom the experimental work was done. The results were most satisfactory, and showed the method to be much better than any one with which the writer is acquainted.

In describing it the words heat, conductivity, etc., are, in accordance with recent usage, applied in a more definite manner than was till recently the custom. The heat is supposed to flow, as electricity does, from a place of high potential to one of low potential. Quantity of heat

corresponds to quantity of electricity. The unit of quantity is the calorie. Temperature corresponds to potential. (Some confusion has arisen lately in regard to this question, it being stated that if temperature is heat potential, its dimensional formula must be unity, while since capacity for heat or specific heat is a numeric, this cannot be the case. The error comes in supposing that specific heat is a numeric, for, from Dulong and Petit's law, the quantity of heat required to raise a body one degree is equal to the unit of kinetic energy multiplied by a numeral. Therefore the dimensions of specific heat are $L^2 M T^{-2}$ and not unity.)

Heat conductivity, or impartivity, corresponds to electrical conductivity, and heat resistance, or morativity, to electrical resistivity. Specific heat corresponds to specific capacity.

The theorem of Fourier referred to may be given as follows:

"If we take a surface and maintain it at a constant temperature so that its loss per second is K calories, and then surround it with a thin shell of conducting material of impartivity i, and thickness t, then the body must be kept at a temperature $3 + ht/i$ times the original temperature in order that the heat loss may be the same, the space between the body and its surrounding shell being very small and filled with air, i being the impartivity of the substance of the shell, and h that of air." This theorem only holds in the case where no heat passes from the body to the shell by radiation. Fourier does not suggest any means of preventing this radiation, and goes on to consider what will be the law of loss when the space between the body and its envelope is small and free from air.

It is evident, however, that radiation can nearly be completely prevented by polishing the surface of the body and the surface of its envelope. For instance, Trowbridge found that the loss of red rays when twice reflected from silver was only 6 per cent., and for the heat rays it would probably be less, as silver has its greatest absorption in the short wave lengths.

We have here a method of cutting down the heat losses in a geometric rate, instead of in an arithmetical one, as is the case when ordinary heat insulating substances, such as asbestos, magnesia, etc., are used. The object of the experiments was to prove whether this theory is correct or not, and though the evidence is scant, owing to the fact that but two envelopes were tried, it will be seen that it held very nearly for the first envelope, and would possibly have held for the second also, but that the two outer envelopes touched at one point, a fact which was not discovered until too late to repeat the experiment; but even then the reduction was very considerable. The body containing the heat source was a polished tin box (no attempt was made to make it brighter than when bought), and the source consisted of a resistance of iron wire, the energy lost being measured by the product of the current passing through the wire into the drop in voltage across its terminals.

(In passing it may be noted that this is probably by far the best means for measuring the heat insulating power of materials which can be used, being far superior to the ordinary methods of measuring by condensed steam, etc.)

The other boxes were also of tin, 1-2 and 1 inch larger, and separated from one another and from the inside box by small pieces of glass tubing. Narrow strips of asbestos were used at first to separate the boxes, but the flow of heat through them was found to be too great; though they were not more than half an inch wide, they entirely vitiated the results, and so the glass was substituted for them.

In making the experiments a steady current was passed through the resistance, and the point noted at which the temperature of the box became constant, or at which, after the lapse of fifteen minutes, there was not a change of one degree. The difference between the temperature of the box and the outside air was then noted, and the watts necessary to maintain that temperature difference. The current was then increased, and a new reading taken, and so on till the highest temperature desired had been obtained, when the process was reversed, and a curve taken for various reductions of current, till the temperature of the box reached that of the air once more. If the up and down curves did not agree, as they sometimes did not, on account of convection currents, which it was impossible to get rid of entirely, the experiment was repeated till they did. The box was then surrounded by another box, or a half-inch wrapping of asbestos, and a new set of observations taken.

In the curves shown in Fig. 1 Curve 1 represents the relation between watt loss of radiation and difference of temperature for the inside box (whose area was six square feet), when both its inside and outside surface were bright.

Curve 2 represents the effect of surrounding the same box, which we will call A, with a wrapping of asbestos board 1-4 inch thick, the surface of the asbestos being left white.

Curve 3 the same, but covering of asbestos 1-2 inch thick.

Curve 4.—Result when box A was surrounded by box B

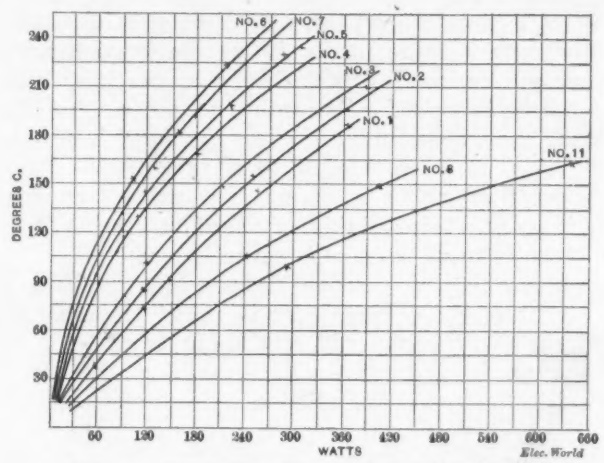


FIG. 1.—CURVES OF HEAT RADIATION.

and separated from it by a few small strips of asbestos; both boxes bright. (The differences of temperature given are in every case the difference betwen that of the inside of the inside box A, and the air in the room, at a distance of 15 feet from the boxes.)

Curve 5.—The same, but separated by bits of glass tubing.

Curve 6.—Box C outside of both box B and box A; all boxes bright. It was afterward found that the top of box B touched the top of box C, but before this was noticed box A had been tarnished and the experiment could not be repeated. In later experiments this was guarded against.

Curve 7.—Same as 6, but with inner box tarnished.

Curve 8.—Box A alone, but painted on inside with gold size and lampblack. Outside surface bright.

Curve 11.—Box A, but both sides coated with lampblack and gold size.

(To be continued.)

A New Telephone Central Exchange.

The Metropolitan Telephone and Telegraph Company opened a new telephone exchange at 95 Broadway, New York City, on Jan. 3, from which 1,000 subscribers in the district bounded by Broadway, Wall street, Battery and East River, are already being served, thus relieving the Cortlandt street station. The new exchange has an ultimate capacity of 3,000, and represents the most modern development of telephone engineering. It contains the latest type of metallic circuit multiple switchboards, and notable features are the ingenious self-restoring indicators, the apparatus for ringing subscribers' bells, for testing lines, for locating troubles and for complete supervision of the work.

Unipolar Dynamos Which Will Generate No Current.

BY CARL HERING.

THE ideal commutator-less unipolar machine which will generate voltages capable of being used for lighting and power, is to many electricians about what perpetual motion was to many mechanics; they are both fascinating ideals on which much brain work, time and money have been spent, but which have both resisted stubbornly every attempt at a solution; they differ in the important respect that every intelligent engineer knows positively that perpetual motion is an impossibility, but in the case of unipolar machines of more than a few volts, the impossibility of the problem has perhaps not yet been demonstrated, and it is doubtless for this reason that so much time is still being devoted to attempts to make such machines, even by very intelligent men. As they have generally, if not always, been unsuccessful attempts, little is heard about them except perhaps in the Patent Office, where the examiners make short work of such applications by resorting to their privilege of requiring "a working model" before proceeding with the case.

As much time, money and intelligent brain work is doubtless still being spent in the attempts at the realization of this fascinating problem, particularly by beginners, the writer will endeavor to show, not that the solution is an impossibility, but that there are certain fundamental principles which may as well be recognized at the start, and which when so recognized will show inventors at once that probably nine-tenths of their designs will not be operative, thus saving them and their capitalists the work and expense of constructing experimental models. Text-books usually describe operative apparatus, but we will here reverse the custom and show what is inoperative. As the fundamental principles to which we are going to call attention are doubtless all well known to those who have a thorough knowledge of the laws of electricity and magnetism, the present remarks are intended more for amateurs and beginners, with the hope that they may save such inventors much time and trouble.

One of the first principles which may be assumed as fundamental is that an electric circuit and a magnetic circuit may both be considered as closed links, shown in Fig. 1.

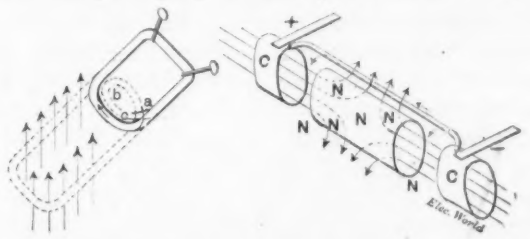
FIGS. 1, 2, 3 AND 4.

The act of linking them together, as shown in Fig. 2, by making one "cut" the other, will generate a current as indicated, while unlinking them, as in Fig. 3, will generate a current in the opposite direction. The unfortunate term unipolar machine may be said to refer to a dynamo in which the current in the armature wire is "unipolar," that is, it does not reverse periodically, as in all other dynamos and alternators, but always has only one direction. In such unipolar induction it is therefore essential that there must either be a continuous linking or a continuous unlinking of the two circuits, for if there is an alternate linking and unlinking it will at once become an ordinary dynamo or alternator. The only possible solution, therefore, is, that one and only one, of these operations must be continuous.

Before proceeding, attention should be called to the fact that a magnetic circuit, although somewhat analogous to a stretched rubber band, cannot be cut like it in order to unlink it, or to get it out of the way, so to speak, without affecting the electric circuit with which it was linked. It appears that the only possible way for a magnetic line of force to be obliterated or gotten out of the way entirely is to allow it to collapse, that is to become smaller and smaller until it is reduced to a point, but in this reduction of its circuit it will "cut" any inductor which was within its circuit; that is, which was linked with it; it appears to be absolutely impossible to unlink it in any other way, except by opening the electric circuit, which, of course, means a commutator or other device for so opening the circuit, and this is the very thing that the unipolar machine is intended to avoid. It is therefore axiomatic that if in a unipolar machine a magnetic and an electric circuit have once been linked together they cannot possibly be unlinked again without reversing the current in the inductor, and thereby making it an ordinary dynamo requiring a commutator. All intended unipolar machines in which the idea is to cut the lines in one direction, then obliterate them or reverse them quickly and cut them again in the opposite direction, will therefore be inoperative.

Let us see how it is possible to cut or link them continuously in one direction. In Fig. 4 the magnetic circuit has been linked once and is being linked again in the same direction. If this is continued indefinitely there will be true unipolar induction, and if the electric circuit is a coil of many turns, any desired voltage may thus be generated. But there does not seem to be any way in which the lines of force can be so twisted and moved; furthermore, this necessarily would "stretch" them and wind them, so to speak, around the coil; but they do not accommodate themselves to such manipulations as stretching to an infinite length or winding around a conductor as a spiral, and it is therefore unlikely that there will ever be a solution of the problem in this direction.

But if instead of manipulating the magnetic circuit the electric current be made to go through the process, the problem is easily solved. This is best shown in Fig. 5, leaving out of consideration at present the dotted loop *a b c*. If the electric circuit be fixed at one part, as shown, and if the other part be made to move through a field represented by the arrows, by stretching it, there will be unipolar induction as long as this motion is continued in one direction. As is well known, this is accomplished in practice as shown in Fig. 6, in which the movement is a circular one, thus permitting the field to be a limited instead of an unlimited one, and the infinite "stretching" of the circuit is then accomplished practically by means of sliding contacts at *C*, *C*. If instead of these sliding contacts the electric circuit be supposed to be winding itself up on these cylinders, it will readily be seen that this method is an equivalent of the one shown in Fig. 4, by supposing the two circuits to be interchanged, making the electrical one the flexible one. These machines are operative, but generate only very few volts; 5 or 10 is believed to be the maximum which has been generated by commercial machines.



FIGS. 5 AND 6.

In many projected unipolar machines, based on this principle, it was thought that if the wire be coiled on itself in some way, as shown by the dotted line *a b c*, Fig. 5, that the electric circuit would then cut the field repeatedly, the E. M. Fs. being in series, thus generating a high E.M.F. This is the principle in probably nine-tenths of the many inopera-

tive unipolar machines. But it will readily be seen that the return wire *a b* cuts the lines just exactly as much as the useful part, *b c*, and what is gained by *b c* is exactly balanced by the volts in the opposite direction in *a b*, and there is absolutely no gain. As the circuit must be a closed link, it must in some way be brought back to one side of the field before it can be made to cut it again. It is the counter-induction in this return wire which makes most of the proposed unipolar machines inoperative. It will always be found, although it may sometimes not be as easily seen as in Fig. 5, that if there is such a return portion of a circuit it will cut the same lines, and an exactly equal number of them, not a single line will escape it.

If this return winding *a b* be fixed like in the first winding, then the machine becomes operative, but it then requires, like the first, a separate sliding contact at each end; if there are no objections to a multiplicity of such contacts, then unipolar machines of any voltage are possible; but there must be two such contacts (in some cases only one) for *each* of these windings.

It has often been claimed that by enclosing this troublesome return wire in an iron tube, or surrounding it by iron, it will be shielded from the lines of force, but this is an error, as a wire enclosed in an iron tube when moved through a field will cut precisely as many lines of force as it would without the iron. The lines (or more correctly, the flux) must pass from one side to the other, and as their circuits cannot be opened, they must cut the wire within the tube.

Another favorite method is to make this return wire cut the lines at a lower speed, say near to the axis, thus generating a lower E. M. F. and leaving an available difference. But this is also an error, as it will always be found that either the field is more intense or else the wire cuts many of the lines where it passes from the periphery to the axis; the lines will always be found to be somewhere, and they will always be cut by this return wire, as they are all closed links.

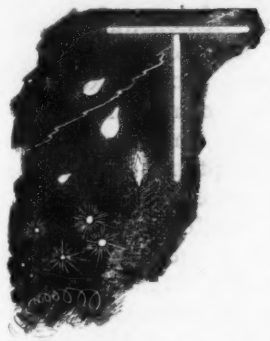
Still another favorite method is to cut the lines rapidly in one direction and slowly in the reverse direction and then utilizing only the higher E. M. Fs. But this is then no longer a unipolar machine. If the equivalent of a flap valve could be introduced to keep out the lower E. M. Fs. (as is done, for instance, when a Leyden jar is charged from a Ruhmkorff coil) such a machine would be operative, but would have a pulsating current with long periods of rest between the pulsations, which would make it practically useless. Although the E. M. F., and therefore the current of the reversed motion, would be smaller, they would last for a longer time.

There is still another principle which is not usually stated in text-books, and which if it had been well known would have saved much work in designing inoperative unipolar machines. It was believed by some that when the lines of force in a unipolar machine reached the armature iron they were carried with this iron and they could in this way be transported, as it were, to some place where they could be released again, meanwhile the circuits have been reversed without induction and are ready to be cut again. Or, in more general terms, it was thought that if an iron core in a coil be revolved, the coil remaining fixed, the lines of force would move with the iron, and not remain fixed with the coil. But this also appears to be an error, as lines of force are said to remain and move with that which generates them; that is, with the coil of an electro-magnet; they are stationary if the coil is stationary and revolve if the coil revolves. This statement is made, however, on the authority of others, the writer not having made any experimental demonstration himself. But whether it be true or not, we believe that it may be safely assumed that a magnetic circuit or link cannot be temporarily opened, as it were, like an electric circuit containing a condenser, and afterwards closed again, keeping its properties; nor can it be stretched out indefinitely and wound around a cylinder, the equivalent of which, in the electric circuit, is accomplished as shown in Fig. 6; if either of these were possible high voltage unipolar machines, with repeated inductions in a coil, would be possible.

It seems therefore that the future of operative unipolar machines lies in the use of large and strong fields, great speeds and more or less numerous sliding contacts; with these it is quite possible to obtain 100 volts, but whether such machines would have any advantages over a well constructed dynamo with a commutator is a question.

The Most Economical Age of Incandescent Lamps.--II.

BY LIEUT. MANNING K. EYRE.



THE first part of this paper appeared in the last issue of this journal, and as the continuation of the subject contains constant references to the tables and curves, published in that issue, these data are here repeated, with the addition of Table III. In the last issue the columns in the tables were marked erroneously, "Total cost." They are here corrected and are marked as they should be, "Lamp cost." The curves A, B and C are the same carbons burned at different efficiencies: A at 3.1 watts, B at 3.6 watts, and C at 4 watts per candle power.

TABLE I.

Life.	Percentage of Candle Power.	Watts Per Candle or Efficiency.
0 hours	100	4.2
100 hours	95.6	4.5
200 hours	90	4.8
300 hours	84	5.0
400 hours	78.4	5.3
500 hours	73	5.6
600 hours	68.6	5.9
700 hours	64.7	6.3
800 hours	62	6.6
900 hours	57.4	6.8
1000 hours	56.6	6.9

TABLE II.

16-c. p. 4.2 Watt Lamp.

Lamp Smashed at	Lamp Cost.	Mean C. P. for 3000 Hrs.	Cost of 1 Candle of Light for 3000 Hrs. When El. H. P. Hour Costs, 3c.	5c.	8c.
200 hours	$5.25	15.2	$0.88	$1.25	$1.79
300 hours	3.50	15.	.77	1.14	1.69
400 hours	2.62	14.4	.75	1.13	1.69
500 hours	2.10	13.9	.75	1.13	1.71
600 hours	1.75	13.4	.75	1.14	1.73
700 hours	1.50	12.9	.745	1.15	1.76
800 hours	1.32	12.5	.745	1.17	1.81
900 hours	1.17	12.	.76	1.19	1.85
1000 hours	1.05	11.6	.77	1.22	1.90

TABLE III.

20-c. p. 3.1 Watt Lamp.

Lamp Smashed at	Lamp Cost.	Mean C. P. for 3000 Hrs.	Cost of 1 Candle of Light for 3000 Hrs. When El. H. P. Hour Costs, 3c.	5c.	8c.
200 hours	$5.25	19.4	$0.655	$0.910	$1.30
300 hours	3.50	18.4	.596	.860	1.27
400 hours	2.62	17.6	.574	.857	1.28
500 hours	2.10	17.1	.560	.852	1.29
600 hours	1.75	16.5	.559	.860	1.31
700 hours	1.50	16.1	.557	.867	1.33
800 hours	1.32	15.7	.560	.878	1.36
900 hours	1.17	15.4	.562	.885	1.38

Table III. is calculated in the same manner as Table II., using as data curve A of Figs. 1, 2 and 3. These curves represent the average performance of a number of modern lamps of

20-c. p. and 3.1 watts per candle power efficiency. A glances at Tables II. and III. will impress any one with the advantages of using, at the present day, 3.1-watt lamps in preference to lower economy, as shown in Table II. Although Table II. represents the performance of 16-c. p. lamps, we find the energy expended per lamp greater throughout than for the 20-c.p. lamp of Table III. The smashing point remains very nearly the same, but the saving of expense per candle of light is very marked. Taking, for instance, the cost of power as 5 cents and smashing both lamps at 500 hours, the cost of a candle of light for 3,000 hours, using the 4.2-watt lamp, is $1.13 and using the 20-c. p. lamp is 85 cents; and in the first case, we have averaged only 13.9 candles of light and in the second case, 17.1. The saving per candle is 28 cents and per lamp $1.18 in 3,000 hours. Supposing the 4.2-watt lamp to be a 20-c. p. lamp of initial efficiency of 4.2-watts, instead of a 16-c. p. lamp, the mean candle power for 500 hours would be 17.4 and the total cost per lamp for 3,000

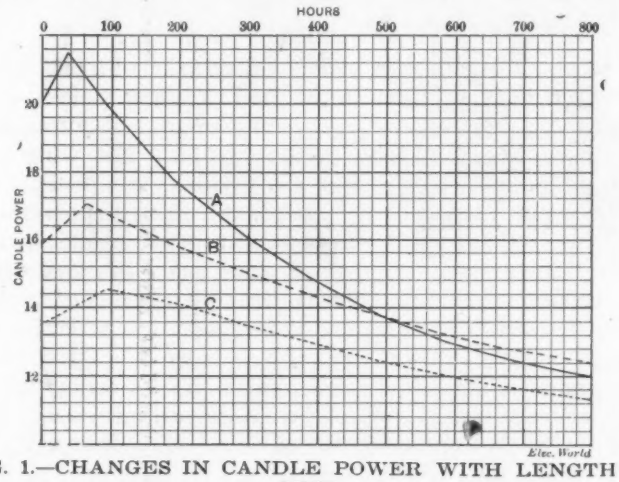


FIG. 1.—CHANGES IN CANDLE POWER WITH LENGTH OF LIFE.

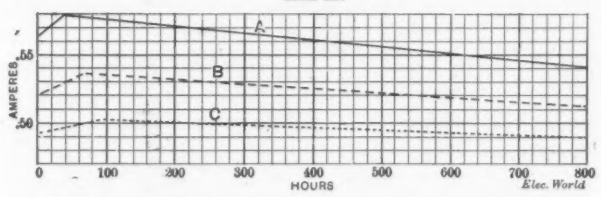


FIG. 2.—CHANGES IN CURRENT CONSUMED.

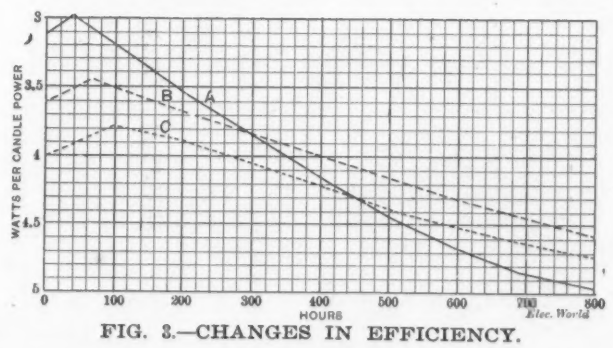


FIG. 3.—CHANGES IN EFFICIENCY.

hours $19.66, while for the 3.1-watt lamp of 20-candle power, the average candle power would be 17.1 and the total cost per lamp for 3,000 hours $14.53. In other words, a man with a 1,000-light plant, paying 5 cents per electrical horse power hour, delivered to the lamps, in 3,000 hours would save, approximately, $5,000 by using a 3.1-watt lamp in preference to the 4.2-watt lamp, smashing either at 500 hours.

Referring again to the smashing point of lamps, by reference to Table I. we see that the candle power, if the lamps are broken at 800 hours, with a cost of power of 3 cents, averages 12, but it must be remembered that for the last 100 hours or so of the run the candle power is down as low as 9 1-2, and the customer is probably complaining bitterly.

To large users of lamps, who buy in large quantities, the first cost of the lamp is much less and this means, of course, that for large consumers the lamp should be broken earlier. Another point that must be remembered is that the above Table II. is for 16-c. p. lamps, and since the price of 20 and 24-c. p. lamps is generally no greater; on the other hand, the cost of power is greatly increased, and this again would induce us to break the lamps earlier. For example, a 24-c. p. lamp takes 50 per cent. more power than a 16, with generally the same cost of lamp; a 32-c. p. lamp takes twice as much power, with a lamp cost generally from 30 per cent. to 50 per cent. higher. Consequently, the higher the candle power of the lamp the sooner it should be renewed to get the most economical and satisfactory results.

Many people will have the impression that if they use 4-watt lamps they can run them economically for a longer time; but by what we have just seen, this is not tenable. If the regulation of a plant is not good enough to warrant the use of a high economy lamp it must be remembered that a low economy lamp on such a plant will act very nearly as a high economy lamp would on a well regulated plant. In other words, a 4-watt lamp on a station whose voltage runs 4 per cent. high will drop in candle power as much as a 3.6-watt lamp on a station where the voltage at no time averages more than 2 per cent. high—and will live no longer.

The curves of Figs. 1, 2 and 3 speak for themselves, and we can only notice from them how well the modern lamp of high economy keeps up its candle power as compared with experiments made two years ago. Another noticeable feature is the increase in candle power and current consumed and the decrease of the watt per candle in the early part of the life of the lamp. If station managers fully realized this fact of the increased consumption of energy during the first three or four hundred hours of the life of the lamp they would not be so ready to state that the average consumption energy per lamp decreased as the lamps burned. A study of the curves of current consumption would show at once that practically up to 800 hours the mean consumption of current is constant. Or, in other words, if these curves were assumed as horizontal lines, the results based on this assumption would be very near the truth.

The above results, concerning the smashing points of lamps, lead me to the following deduction:

Let M = cost per lamp exclusive of renewals.
Let P = the normal candle power.
Let K = decrease in candle power per hour of life.
Let L = cost of one lamp.
Let y = the number of hours lamp has burned at any time.
Let x = the cost per candle power hour during any time y

On the assumption that the candle power decreases uniformly with the life of a lamp (which assumption is so near to the truth that it will be sufficient for the deduction of an approximate formula) the mean candle power for any time y is

$$P = \frac{Ky}{2}$$

Then for the cost per candle power x for any time y we have

$$X = \frac{M + \frac{L}{y}}{P - \frac{Ky}{2}}$$

Reducing

$$X = \frac{2L + 2My}{2Py - Ky^2}$$

Differentiating and putting

$$\frac{dx}{dy} = 0,$$

we have for the value of y, at which power hour x is a minimum, cost per candle

$$y = \sqrt{\frac{2\,(LP - K)}{K \times M}}$$

Example :-$L = 35$ cents ; $P = 16$ c. p.; K, from the curve of table II, $= .008$; $M = 3\text{-}4$ cent.

Solving the equation for these values, we have for the value of y, at which the cost per candle power hour is a minimum, 430 hours.

For practical purposes this formula can be reduced to

$$y = \sqrt{\frac{2\,L\,P}{K\,M}}$$

This formula is only approximately true and its value is perhaps questionable; nevertheless, it is inserted here in hopes that it may be useful to some.

A New Lamp Board.

BY GEO. D. SHEPARDSON.

ONE of the necessary adjuncts of an electrical laboratory or testing room is an absorption rheostat that may be left in circuit continuously to dissipate energy. For many purposes, such as taking magnetic or dynamo curves or calibrating instruments, it is necessary that the resistance be changed from high to low values by more or less definite amounts, and that at each change it takes a certain fixed value. Iron wire strip tin, carbon blocks, powdered carbon, liquid solutions, in fact most substances except expensive alloys, are unsuitable for such purposes, because on account of temperature changes the resistance alters after the current is turned on or is changed. Such resistance is also affected to some extent by draughts of air. When an iron wire coil is connected across a constant potential circuit the current that

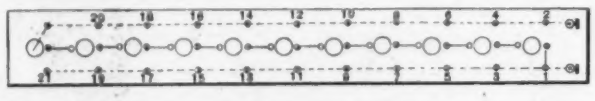


FIG. 1.

passes is that due to the voltage divided by the cold resistance of the iron. In a few seconds the iron becomes heated, its resistance increases, and the current decreases. Such uncontrollable changes in current strength are fatal to accuracy in many lines of work. Perhaps this is one reason why the method of reversals gives higher values in hysteresis curves than the step-to-step method.

Incandescent lamps have long been recognized as being a convenient, economical and reliable means of dissipating definite amounts of energy. When the filaments are small they reach a constant temperature and resistance almost the instant current is turned on. They are not sensibly affected

FIG. 2.

by air draughts. They may be arranged to give a wide variation in resistance with ease, certainty and rapidity.

One form of lamp board designed and made in the electrical laboratories of the University of Minnesota is shown in the accompanying sketches. Figs. 1 and 2 show a plan and elevation. Eleven lamps with Edison bases are so arranged as to be connected in series, parallel or any intermediate combination by the movement of three-way switches. Each socket consists of a device known and used by the writer since 1887, and is similar to sockets now upon the market.

In constructing these lamp boards, brass wire about one-sixteenth inch thick was wound into a long spiral on a mandrel seven-eighths inch in diameter. (The proper diameter of mandrel will vary with the stiffness of the wire, and should be determined by experiment. This spiral was cut into pieces containing six turns each. Three turns of each piece were straightened and beat so as to be parallel to the axis of the coil. The other end of the wire was bent out so as to

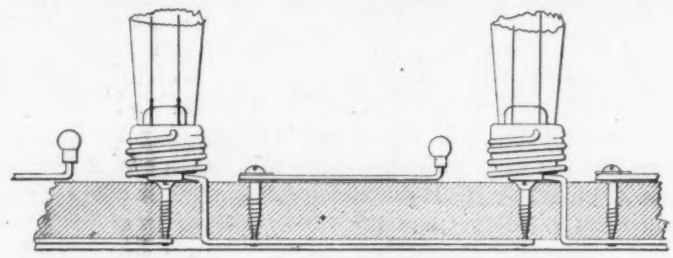


FIG. 3.

project about one-quarter inch. On one side of a pine board 6 inches wide, 5 feet long and 1 inch thick, were sawed three grooves a quarter inch deep, one about an inch from each edge and one in the middle. The wire coils were placed about 5 inches apart along the medial line on the opposite side of the board, the straight portions of the wire being passed through and bent in the middle groove as shown in Fig. 3. A flat-headed brass screw at the centre of each coil passes through the board and is soldered to the end from the next socket. The lamps are inserted by untwisting the spiral by means of the projecting upper end of the wire noted above, and screwing in the lamp until the terminal cap strikes the flat-head screw. The outer terminal of one lamp is thus electrically connected with the inner terminal of the next.

TABLE SHOWING CURRENTS WITH DIFFERENT POSITIONS OF SWITCHES.

Current.	Switches closed.										
.03	1										
.04	3										
.05	5										
.06	7										
.07	9										
.08	11										3
.1	13										
.12	15										
.18	17										
.22	17	2									
.23	17	4									
.25	17	6									
.27	17	8									
.29	17	10									
.33	17	12									
.40	17	12	1								
.44	17	12	3								
.5	17	12	5								
.59	19	17	12	5							
.68	19	17	15	12	5						
.78	19	15	12	7	5						
.93	19	15	12	7	2						
1.03	19	15	12	7	4						
1.4	21	19	15	12	7	4					
1.8	21	15	13	12	7	4					
2.2	21	13	12	9	7	4					
2.53	21	13	12	9	7	5	4				
3.03	21	18	13	12	9	7	5	4			
3.4	21	20	18	13	12	9	5	4			
3.75	21	20	18	16	13	12	9	5	4		
4.4	21	20	16	13	12	9	5	4	1		
5.7	21	20	16	13	12	9	8	5	4	1	
6.93	21	20	17	16	13	12	9	8	5	4	1

A stout wire is laid in each of the outer grooves in the board and is soldered to the points of round-headed brass screws opposite each lamp, and also fastened to a binding screw at one end. Wires with insulating handles pivot about round-headed brass screws which are soldered to the wires connecting the sockets. When turned to one side or the other these connect the lamps with either main lead, the

screws on the sides all being turned with the slots in such a direction as to receive the tongues of the switches. The various screws being numbered, we may connect the lamps in any combination of series or parallel. When all the switches are in the medial position the circuit is entirely open. When the switch near the terminals is thrown over to post No. 1 as shown in Fig. 1, the lamps are all in series, the central screw of the last lamp being permanently connected to one lead wire as shown by the dotted line.

The accompanying table shows the currents obtained with different positions of the switches, the potential of the dynamo varying between 112 and 108 volts.

This lamp board has proven so satisfactory that it is intended to construct others with more lamps and a correspondingly greater and more uniform range.

THE ELECTRICAL INDUSTRY COURAGEOUSLY FACES THE SITUATION.

Electric Cooking.

The advent of electric cooking apparatus seems likely to evolve a highly scientific species of cook, with, we may be sure, highly up-to-date notions about the "living wage." "Cookery," we are told by a daily contemporary in a description of the electric process, "is raised from the rule-of-thumb level to that of an exact science by the use of a graduated thermometer. For bread or puff pastry a temperature of 370 deg. Fah. is required; for pork, veal, or ordinary pastry, 350 deg.; for beef, 340 deg."; and so on. All this must mean a table of constants in the kitchen, with possible formulae with different coefficients for jam tarts, mince pies and Christmas puddings. Perhaps some method of integrating the specific heats, latent heats, and density of the heterogeneous mass to be cooked will be found necessary before the temperature can be finally determined. This will mean Royal Society Papers on the subject. Besides all this, the cooking appliances are depicted as being fitted with a whole battery of switches, various combinations of which, like the stops on an organ, will be necessary to produce various effects. "Afterward," says our contemporary, in an account of the destructive distillation of a joint, "four of these switches are turned off, and the heat is applied from one side only." Just think of the high scientific knowledge required in order to be able to manipulate these cookery stops, so as to produce any given thermal distribution on the three Cartesian axes of the kitchen oven!

Refuse Utilization Scheme.

A scheme of electric lighting by power derived from refuse, says the London "Electrician," has been drawn up, and is intended to be tried at Harrogate. The process in outline is as follows: The refuse is brought in carts or otherwise and tipped upon a platform, whence it is automatically carried into a rough-sifting apparatus which separates the old pots, cans, etc., the smaller material passing through the sifter into a large hopper, from which it is forced in regular quantities into a drying cylinder. It then passes on to another sifter which takes out the fine dust, the resultant fuel being injected into the boiler furnaces.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS.

BY CARL HERING.

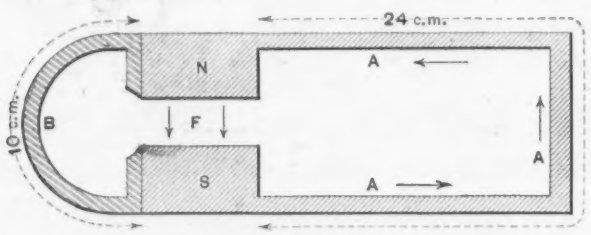
ELECTRO-PHYSICS.

Electricity.—In an editorial in the Lond. "Elec. Rev.," Dec. 22, in which attention is called to the one in The Electrical World, Dec. 2, it is questioned whether the theory of electricity is so far behind the theories of light, heat, chemical action and gravitation; Maxwell's theory of light has gone far to make the theories of light and heat merely the particular cases of electricity; Lodge appears to believe electricity to be of the nature of a material fluid, whose locomotion, radiation or vibration produced the electric current, magnetism or light; Poynting does not believe in the substantiability of electricity, and thinks that the electric energy does not flow along the wire, but takes short cuts to it through the dielectric; the ether has until recently been considered to have the properties of an elastic solid, but it has now been found necessary to abandon this position; Mr. Glazebrook recently stated that the elastic solid theory of the ether had failed and suggested as a substitute Lord Kelvin's labile, or froth ether; the great objection to the former is that it cannot transmit transverse vibrations without, at the same time, transmitting longitudinal vibrations, which is inconsistent with the known phenomena of light; the labile ether, whose elasticity is due to surface tension, transmits transverse, but not longitudinal, waves; Lord Kelvin's molecule and vortex sponge theories give better explanations in many points than the labile ether theory.

Oscillations in Cylindrical Conductors.—Mr. Blondin's mathematical article is continued in "La Lum. Elec.," Dec. 16.

MAGNETISM.

Compensation for Hysteresis.—In the Lond. "Elec. Rev.," Dec. 22, the following method, devised by Prof. Perry, is described. In the accompanying figure *A A A*, is the electro-



COMPENSATION FOR HYSTERESIS.

magnet, and *B* a strip of permanent magnetic steel placed as a shunt to the field *F*; when excited the lines have the direction as indicated, and when the current is broken the lines due to hysteresis still circulate in *A* and *B*, in the same direction; if the length and section of *B*, taking into account the greater residual magnetism of the steel, are chosen so that the number of lines of force in *B*, shall be equal to the number in *A*, then none shall appear in *F*. The magnetization curve of *B* may bear such a relation to that of *A* that through all decreasing currents the extra induction in *A* due to hysteresis would be just balanced or taken up by the induction in *B*. An ingenious apparatus is described and illustrated for measuring the field; it consists of a modified Lippmann instrument. One of the best curves obtained from experiments is given, together with that for the iron alone; the addition of the steel reduces the strength of the field 25 per cent., but the effective hysteresis is reduced to practically nothing; the sectional area of the steel was 0.4 times that of the iron; it was found that the section of the steel must be very great, reducing the field to less than one-third, and in order to enable a smaller section of steel to be used, the reluctance of the iron circuit was increased by an adjustable gap, produced by inserting a piece of brass in the magnetic circuit in the yoke piece. Representing the magneto-motive force in the iron and steel by *M* and *m*, respectively, and the reluctances by *R* and *r*, then the condition in which there will be no flux across *F* is $m \div M = r \div R$; the latter ratio may be decreased by increasing *R*, and this is done by means of the air-gap; this removal of a restriction as to the length and section of the steel facilities the obtaining coincidence in other parts of the curve; the experiments were not wholly successful, showing that if the current was reversed it was necessary to increase it to the same maximum as before in order to get satisfactory results; the method is, therefore, practicable only when the current is never reversed; if, however, the current be passed around the steel also, it is possible to reverse both simultaneously.

Magnetic Rotation.—The Lond. "Elec. Eng.," Dec. 22, quotes briefly from a chemical society paper by Mr. Perkin.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Insulation and Fault Detection in Three-Wire Systems.—The Lond. "Elec. Eng.," Dec. 22, reprints an interesting paper by Mr. Wilson, describing the method used at the Glasgow station. The description is too long to be fully abstracted here, but the principle is briefly as follows: Two multicellular voltmeters are connected in series between the positive and negative wires, the connection between them being led to earth; as one of the lines becomes grounded the corresponding voltmeter will fall to nearly nothing, while the other will rise; if the fault is on the neutral wire they will both read exactly 100 on a 100-volt circuit; this indicates on what line the fault lies; to calculate the absolute insulation the voltmeter readings are taken and also the current leakage from each two of the wires by connecting the other through a low-resistance ammeter to earth; this gives three current readings, from which, together with the potential readings, and measurements, made with an auxiliary resistance put in parallel with the greater of the two insulations, the insulation resistance may be calculated by a method which he gives; this is done every morning and requires but three minutes; the insulation resistance required from the customers is 60 megohms per lamp, the mains being fully up to this standard; the voltmeters must be electrostatic or otherwise this is a modification of the well-known lamp-test, which, he says, is of no real value except to mislead the public, for which purpose he claims it is often used; if, for instance, the insulation is very low all over in comparison with the lamp resistance, the lamps will not glow unless there is a heavy fault. For locating the faults without

disconnecting the wires he uses a pocket compass in the manholes, laying it on one of the faulty feeders, bringing it back to parallelism with the wire by means of a strong bar-magnet, after which the other side of the system is momentarily earthed, giving the direction and roughly the magnitude of the current by the throw of the compass needle; the feeder on which the largest current goes to the fault is noted; this is repeated at successive manholes until the point is reached where the direction of the earth-seeking current is reversed, the fault must lie betwen this and the last manhole; by means of a straight length of 20 feet of insulated wire and a telephone, the wire being led (on the surface of the street) parallel to the conductor, a buzzing will be heard in the telephone when a momentary current passes through that conductor; as this wire is carried along, the noise ceases when the fault is past, and in this way, he states, that the fault can be located to within a yard; faults below 10 ohms can thus be found, those greater than this can safely be left alone as they will soon get either worse or better; the system has been very successful in Glasgow.

Measurements at Central Stations.—Dr. Kallmann's article is continued at some length in the "Elek. Zeit.," Dec. 22; he discusses the measurement of the mean and individual voltages of the circuits and the measurement of the voltage of the machines.

Double Registering Meter.—In "L'Elec.," Dec. 16, Mr. Haubtmann calls attention to the importance of supplying current at cheaper rates from central stations during the daytime, chiefly for power purposes, stating that the same would be advantageous to both the consumer and the central station. He adds an illustrated description of the device of Messrs. Dreyfus and Roche, which, it appears, can be added to a meter enabling it to register at different rates during the day hours; neither the illustrations nor the description are as clear as might be desired, but the apparatus appears to consist of a double set of registering dials which are thrown into action alternately at any desired hours by a clock, the shaft of which turns once in every twenty-four hours; it can easily be made to change the readings to different hours according to the season of the year.

Measuring the Earth Connections of Lightning Rods.—Mr. Wiechert describes in the "Elek. Zeit.," Dec. 22, a new method devised by himself which has been in use for some time and has been found very satisfactory; the apparatus used is a Weinhold telephone bridge (a Wheatstone bridge in which a telephone and Ruhmkorff coil are used in place of the galvanometer and the battery); if there are not two separate grounds to the lightning-rod, a second one must be made, besides which an earth contact must be made, as for instance, by means of an iron wire run into the earth, which is moistened with water; a bridge wire with sliding contact forms two arms of the bridge, the ground connection to be measured forms the third, while the fourth is, in one case, a resistance of 10 ohms, in series with the second earth connection, the telephone being connected to the auxiliary earth contact, the resistance of which does not enter; in the second case it consists of the resistance of 10 ohms alone, the second earth connection being then in series with the first, and constituting with it the other arm of the bridge; by means of this double measurement the resistance of each of the two ground connections is readily obtained; a diagram showing the connections is given in the article.

Self-induction.—In "Ind. and Iron," Dec. 17, J. S. state that an electric circuit has unit self-induction when, if the current increases at the rate of an ampere per second, there is a back E. M. F. of one volt; a self-induction of one henry may therefore be defined as such, that if there is one ampere the product of the turns by the total induction enclosed by each of them is 10^8 magnetic reluctance and self-induction are thus seen to be closely related; the former considers the magnetic circuit only while the latter considers the number of turns also; if the magnetic reluctance is taken as the magnetic potential divided by the total induction, it is a reciprocal of the self-induction where there is only one turn of the wire; the self-induction is the reciprocal of the magnetic reluctance multiplied by the square of the number of turns.

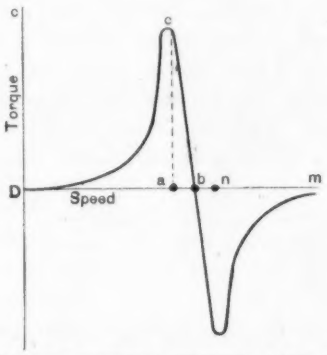
Impedance of Mutually Inductive Circuits Containing Capacities.—Referring to Mr. Kennelly's article in The Electrical World, Oct. 21, Mr. Rimington, in the Lond. "Elec. Rev.," Dec. 22, calls attention to his (Rimington) recent Physical Society paper on "An Air Core Transformer" (see Digest, Nov. 25), which, he says, with but a slight modification in case of capacity, gives a similar method to that of Mr. Kennelly, but which he claims is simpler; he then discusses his method together with the modification necessary when one or both of the circuits contain a capacity. The article does not admit of being abstracted; it is to be continued.

Bristol Recording Voltmeter.—The Lond. "Elec. Rev.," Dec. 22, contains a short illustrated description of this voltmeter.

Shunts.—The Lond. "Elec. Eng.," Dec. 22, contains two communications regarding shunts, but they apparently contain nothing new.

DYNAMOS AND MOTORS.

Experiments with Brown's Non-Synchronizing Motors.—The Lond. "Elec. Rev.," Dec. 22, contains the first part of an article on this subject, in which the principle is briefly



RELATION BETWEEN SPEED AND TORQUE.

described; the accompanying diagram of Dr. Sahulka (which was described but incorrectly reproduced in the Digest, July 29), is discussed; it shows the relation between the speed and the torque; between o and a the speed falls for an increasing torque, showing that when the motor starts the tendency of the load is to decrease the speed and thereby the torque, thus bringing it to a stop; between a and b the reverse is the case and the motor should therefore be used between those points; the point n represents the synchronous speed; it is stated that the calculations from which this curve is derived are based on special hypotheses and will be very different if the motor is properly constructed; experiments with these motors are promised in the next portion.

Theory of Rotary Field Motors.—The discussion between Mr. Boucherot and Mr. Farman, mentioned before in these columns, is concluded in "La Lum. Elec.," Dec. 16, which contains a short article by the former and a communication from each of them.

Pyke and Harris Dynamo.—The Lond. "Elec. Rev.," Dec. 22, gives a short illustrated description of this continuous-current dynamo.

ARC AND INCANDESCENT LIGHTS.

Arc Lighting.—Mr. Carter's serial is continued in the Lond. "Elec. Rev.," Dec. 22, in which he discusses the de-

sign of arc lamps; he classifies them by dividing them into continuous and alternating current lamps for series and for parallel working, and describes continuous current lamps for series working, using the Brush lamp as a typical one of that class.

TRANSMISSION OF POWER.

Transmission of Power at Niagara Falls.—The conclusion of the discussion of Prof. Forbes' paper is given briefly in the Lond. "Elec. Eng.," Dec. 22. The Lond. "Elec.," Dec. 22, gives the whole discussion at the two meetings in abstract, as revised by the speakers; the following is an abstract of the remaining portion, which has not already been given in these columns. Mr. Ferranti states that the question of transforming up was, in practice, a very awkward one, it led to many objectionable results, and was especially bad where it was combined with other dynamos working directly on the circuit at high pressure; he thought that it was a great fallacy to assume that 20,000 volts, with both poles insulated, was as safe as 10,000 volts with one pole to earth; with two cables, both insulated from earth, it was exceedingly unstable and dangerous; regarding the frequency he thinks 40 would have been more satisfactory, being about the happy medium; 100 or even 80, as at Deptford, would be fatal to an economical working of the system; regarding the transmission to very great distances he said that while he did not see the faintest chance of its being done with continuous currents, with our present knowledge, he at the same time saw very grave difficulties in the way of doing it by alternating currents. Mr. Alexander Siemens did not think there was any question about using 20,000 volts on underground cables; he would be perfectly ready to supply such cables; the project for the Niagara plant made by his company was for continuous currents, and he was not sure that the Cataract Company would not be converted to the continuous current system before they had finished. Mr. Evershed called attention to the induction between the conductors of the lines, which he calculates to be 880 volt per mile at a frequency of 100 for 333 amperes per square inch, 3 square inches in cross-section and 6 inches apart, while at 25 periods it was reduced to 192 volts, the resistance drop being 27 volts; this he thinks is an important argument in favor of low frequency. Mr. Crompton states that a question of great interest, namely the cost of power in Buffalo, had been entirely omitted; he thinks that if an arc started at one end of the subway it would travel the whole 18 miles in a very short time; he did not appear to favor porcelain insulators; after a long trial he considers oil insulators entirely useless; he did not think continuous currents had been condemned on sufficient evidence; he thinks that grave difficulties exist in coupling alternators in parallel; he did not think 40 periods enough to produce good lighting, as he had seen many Gantz stations where the lighting at 42 periods was disgraceful. Mr. Brown, of Oerlikon, through Mr. Kapp, advocated a higher frequency, and stated that he had been unable to detect any difference in parallel coupling between frequencies of 15 and 100; he has never found any difficulty in running machines, even of very different types, in parallel under the most difficult conditions, and he believes their coupling is even easier than that of direct current machines; he approves of the two-phase system with four wires; he believes that the machine decided upon was the worst possible arrangement, it was impossible to get at the machine while in motion, and the ventilating effect of the revolving armature was entirely lost. Quite a number of those who discussed the paper criticised very severely the action of the Niagara company in soliciting designs and plans and then rejecting them all, but using the suggestions in making their own designs; Mr. Crompton stated "the barefaced attempt to take the brains of the world and then utilize the information gained for the benefit of the American manufacturers was a thing to be admired." Mr. Ferranti said that "it was upon the work of the world, unrecompensed, that the undertaking would be carried out at Niagara." Prof. Forbes replied at some length, particularly to the remarks of Mr. Mordey, but gave nothing new; he claims that the only serious mistake which he made was to recommend the adoption of the Mordey alternators; he thinks that most of the speakers did not realize the real nature and scope of the problem, and he believes that they would, after further study, ultimately arrive at his position; his own opinions had been strongly confirmed by the general results of the discussion. Editorially the "Elec." says that this paper should never have been presented to an engineering society, that the subject was unripe for discussion, and that many details were unanimously condemned by practical engineers; "the less said about Prof. Forbes' reply the better"; it refers to some experiments in parallel running made in July, 1891.

Utilization of Water Power.—The Lond. "Elec.," Dec. 22, quotes briefly from a report made for a proposed plant in India, in which power is to be transmitted to Madras, 350 miles distant, where it is claimed that electricity at low pressure will be supplied at about $19.40 per h. p. per annum, and in which Prof. Forbes prefers the two-phase system, and decides on units of 5,000 h. p., generating from 50,000 to 40,000 volts, at a frequency of 50.

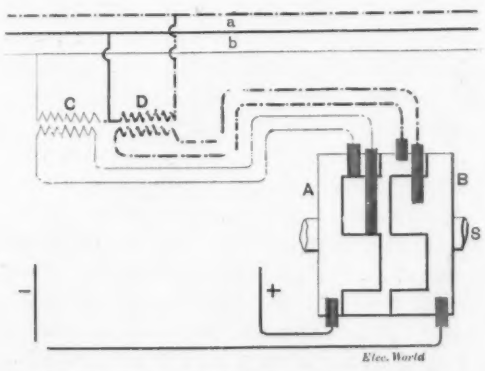
Transmission of Power from Central Stations.—Prof. Unwin's sixth lecture is concluded in the Lond. "Elec. Eng.," Dec. 22.

ELECTRIC RAILWAYS.

Return Railway Circuits.—The General Electric Company of Berlin state in the "Elek. Ziet.," Dec. 22, that in the railway at Halle they have avoided the use of earth plates, the whole of the return current passing through the rails and through wires laid in the ground between them (presumably to avoid the evil effects of the current in the earth).

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Two-Phase System.—Mr. Kennedy's article is concluded in the Lond. "Elec. Rev.," Dec. 22. This serial was abstracted in the Digest, Nov. 18, 25, Dec. 9, 23, 30 and Jan.



KENNEDY TWO-PHASE SYSTEM.

6. He describes several converters, meaning by that term an apparatus for changing alternating into continuous currents without transforming them to a higher or lower potential. The adjoining cut shows one of his own designs for two-phase currents; the shaft *S* of the double commutator *A B* is driven by a self-starting synchronizing motor; *C* and *D* are transformers for reducing the high tension current; it will be seen that the two secondary currents are commutated and put in series; for high pressures and small currents he states that this works very well; for low pressures and large currents the continuous currents are coupled in parallel by the commutator, each being taken off only during a portion of the time of one wave, that is, only down to the point where the waves intersect each other, at the point where

their pressures are equal; this apparatus is illustrated and consists simply of a four-part commutator and a single pair of brushes, the two transformers being connected respectively to two opposite segments; each current is in contact with the brushes for one quarter of a revolution only; as there would be sparking, the segments overlap slightly as in a Brush dynamo, in order to prolong the contact by lengthening the segments in the opposite direction from the rotation, by which means the rising pressure of one transformer overpowers and partially reverses the current before breaking the contact. He calls attention to the fact that the Brush arc light machine is much easier explained by considering it as a multiphase generator, in which the currents are rectified and put in series; this dynamo, he says, makes an excellent two or three-phase generator, motor or converter from alternating to continuous currents; the same is true of the Thomson-Houston arc dynamo for three-phase currents. He also describes the Appolony method for single-phase currents, which can be combined to advantage with the Hutin and Leblanc series coupling. In conclusion, he speaks again of the advantages of the two-phase system as compared with those at present in use, saying that "direct supply from the generators is a barbaric stage through which the art is at present passing."

Polyphase Currents.—The serial in the Lond. "Elec. Eng." is concluded in the issue of Dec. 22: a number of simple motor formulas are given, but it is stated that it is almost impossible to arrive at any calculations of this kind that shall be absolutely general; owing to the very small number of such motors constructed, there are few experimental facts at hand regarding the values to be given to factors of equations and the formulas given must therefore be regarded as indicating a direction rather than an exact path. The paper is concluded by a discussion of the transforming of polyphase currents into continuous currents, in which the usual well-known method is described.

Rotary Field Apparatus.—Mr. Blondel's mathematical article on an elementary theory of rotary field apparatus is continued in "La Lum. Elec.," Dec. 16; among other things he compares the star and polygon system of windings, giving a table of the various constants in each case and their ratios.

Cost of Running an Alternating Current Station.—In Lond. "Elec.," Dec. 22, Mr. Feldmann gives a very complete set of figures from the official report of the Cologne station for one year; a table is given comparing the cost of gas and electric lighting in seven different German cities, showing that the latter is from 25 to 75 per cent. higher; also tables showing the distribution of the load among the various consumers; by far the largest consumer is the station itself, next come factories, workshops and warehouses, then restaurants and hotels, the smallest consumption being in private houses; a table is given showing the distribution of the costs, that for coal being about 1.55 cents per kilowatt-hour, and the total cost 6.59 cents per kilowatt-hour; another table gives the distribution of the income, showing a total of 17.6 cents per kilowatt-hour; the total output was about 308,000 kilowatt-hours and the total net earnings about $37,000; the price per kilowatt-hour is about 19.1 cents, and including the rebate, 18.4 cents; the cost of the current for power has been reduced to 6 cents with additional rebates for large consumers. Editorially the "Journal" states that these costs are better than the best figures in London.

Driving Alternators in Parallel by Gas Engines.—Mr. Dowson, a gas engineer, discusses this question in the Lond. "Elec.," Dec. 22, stating that while he does not deny that alternators can be so driven, he does not believe that it has yet been done, and he does not seem to advocate it; the extra complication involved in increasing the number of impulses in a gas engine is very great, and he does not think that such engines will be used to a great extent; he speaks favorably of the two-phase system devised by Mr. Kennedy (which has been fully abstracted in the Digest), and which he thinks simplifies greatly the use of the gas engines for generating alternating currents and avoids the trouble of driving them in parallel.

Refuse Utilization for Harrogate.—According to the Lond. "Elec.," Dec. 22, a scheme is to be tried in that city for electric lighting by power derived from refuse.

Automatic Accumulator Switch.—The Fery apparatus is illustrated and described in "La Lum. Elec.," Dec. 16; the magnet which operates the mercury cut-outs consists of two parts, one being wound for a series current and the other for a shunt or potential current, the magnetic action of the two being alike so as to aid each other; the latter is connected either to the dynamo or the accumulator; it can be used also for automatic coupling or uncoupling dynamos running in parallel.

Edwards' Steam Turbine.—"La Lum. Elec.," Dec. 16, gives a well illustrated description of this steam turbine, which contains one disc moving between two others, the curved turbine blades being contained on the adjacent surfaces.

Fuel Economy.—The Lond. "Elec. Rev.," Dec. 22, contains a communication on this subject.

WIRES, WIRING AND CONDUITS.

Networks of Conductors.—Mr. Coltri's article, mentioned in the Digest Dec. 30, is continued in "La Lum. Elec.," Dec. 9.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Station at Paris.—The article describing this station, mentioned in the Digest last week, is concluded in "L'Elec.," Dec. 16; the description is somewhat lengthy and includes 17 cuts.

Statistics for France.—The Lond. "Elec.," Dec. 22, gives briefly some telegraph statistics for France for the year 1892.

ELECTRO-CHEMISTRY.

Purification of Sewage.—In "La Lum.," Dec. 16, Mr. Rigaut gives a short illustrated description of the Hermite apparatus as used at Havre and Lorient; the illustrations include a view of the electrolyzer, an interior view of the building with the apparatus and a complete apparatus with tanks. Sea water is passed through the apparatus where it is partially electrolyzed, after which it is conducted through a system of lead pipes to the various houses, where it can be drawn upon at will for disinfecting purposes; the disinfecting action is due to chlorine which is developed; it is stated that by this means the germs are destroyed, but the fertilizing properties of the sewage are not impaired; the destruction of the germs seems to be absolute, as tests have shown that they do not afterwards develop again; from experiments it has been found that the electrolyzing should be such that the resulting liquid contains from 0.1 to 0.05 gramme of chlorine per litre; each group of apparatus contains a dynamo developing from 1,000 to 1,200 h. p. at 6 to 7 volts and a pump circulates the water at the rate of about 600 litres per minute; it is estimated that the cost of an installation for thus disinfecting sewage by means of sea water will cost about 2 francs (40 cents) per year per head of population, and it is said to be no more expensive than other processes; the installation appears to be quite successful.

Electric Purification of Sewage.—A paper by Mr. Williams, reprinted in "Ind. and Iron," Dec. 22, describes briefly the electric process for which he thinks there is no future, as the cost must be very high; the sewage flows through a series of brick cells, entering alternately at the top and bottom; the cells consist of a number of cast-iron plates,

half an inch thick, connected alternately with two poles of the dynamos; the hydrogen gas evolved carries up the suspended matter which afterwards settles; the iron is dissolved from the positive plates and is precipitated as ferrous hydrate, carrying down with it the suspended matter; it is simply the dissolved iron which accomplishes the work and this is obtained by a very expensive process.

Lead-Dust Accumulators.—In a paper by Mr. Huber (of the company making these accumulators), abstracted in the "Elek. Zeit.," Dec. 22, he states the advantages claimed for these accumulators, in which the object is to increase the ratio of the surface exposed in proportion to the volume of the material; the lead-dust is made by blowing superheated steam through a tube immersed in the molten lead, which converts the lead into a fine dust; this has the property of being capable of being pressed into coherent plates or into a grid, remaining quite porous; care must be taken that this dust does not oxidize, which is accomplished by keeping it under water; it is then mixed with a neutral porous body (the nature of which is not stated), and pressed into grids. In the discussion Mr. Pollak stated that the process was not new, as it had been tried and abandoned in England a number of years ago; he thinks that the principal fault of accumulators, namely, the sulphating between the active material and the conductor, is not overcome by this method; the value of such a method can only be determined after several years of use of the accumulators.

A translation of the article by Mr. Liebenow, abstracted in the Digest. Nov. 25, is given more fully in the Lond. "Elec. Rev.," Dec. 22.

Dangers of the Lead Industry.—The Lond. "Elec.," Dec. 22, publishes an official report regarding the dangers to the workmen in the manufacturing of accumulators. The process is briefly described and recommendations are made.

Electrolysis of Fused Salts.—Mr. Andreoli's serial is continued in "Ind. and Iron," Dec. 22; he mentions a number of properties of materials when heated, showing some of the difficulties involved in such electrolysis; he describes briefly, together with some illustrations, the first attempts, made many years ago, to apply the electric current to heating and metallurgy.

Craney Electrolyzer.—"La Lum. Elec.," Dec. 16, contains a short, well illustrated description; one electrode consists of granules of carbon in the bottom of a vessel while the other is made of a band of metal in another vessel, the two vessels being connected by means of a siphon.

Silver Plating Industry.—The serial in "Ind. and Iron" is continued in the issue of Dec. 22; the subject of scouring being described.

Dissociation.—The Lond. "Elec. Rev.," Dec. 22, notices briefly some articles in scientific papers.

The Color and Speed of the Ions.—The Lond. "Elec. Rev.," Dec. 22, calls attention to articles in "Zeit. Phys. Chem.," 9, p. 579; also 12, p. 56, and "Ann. d. Phys. u. Chem.," No. 11.

Decomposition of Organic Compounds.—The Lond. "Elec. Rev.," Dec. 22, contains a short note on some recent researches.

MISCELLANEOUS.

Electric Ignition of Benzine in Laundries.—The "Elek. Zeit.," Dec. 22, states a peculiar case in which Dr. Richter, of Hamburg, has shown that most of the frequent fires occurring in chemical laundries where clothes are washed in benzine are caused by the sparks due to the electricity generated by the friction of the benzine and the articles of clothing as they are rinsed and withdrawn from the bath; from statistics in Hamburg it is claimed that 15 out of 21 of such fires were due to this cause; a large number of careful experiments were made, in which it was found that the woollen material becomes positive and the benzine negative; the discharge on withdrawing materials from the bath is often great enough to be painful, and in several cases the experimenter was thrown to the ground and for some time after could not stand up; in a dark room the discharges produced quite an illumination and have a number of different forms, some of the discharges being two inches in length; with higher temperatures and with more moisture in the air there is less tendency to fire than in cold, dry rooms; he also found that the greater the amount of dust in the air the less is the danger. (No suggestions are made regarding methods for preventing such fires; the danger might possibly be greatly diminished by charging the air in the room with steam.)

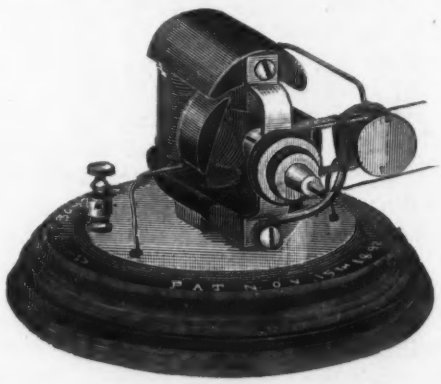
Saladin Furnace.—The "Bul. de la Soc. Chem.," Vol. 9, No. 5, contains a paper by Mr. Saladin, describing a new furnace, an abstract of which is given in the Lond. "Elec. Rev.," Dec. 22; a platinum spiral placed in a vessel of refractory material and enclosed in a cast-steel case is heated to incandescence by means of a continuous or alternating current; the materials to be heated may be subjected to a high pressure up to 1,000 atmospheres; the temperature is from 1,500 to 1,800 degrees C. and is measured by a platinum-rhodium couple; it is used for the experimental reproduction of minerals from elementary matter by imitating the probable conditions under which they were naturally formed.

Welding.—In "La Lum. Elec.," Dec. 16, Mr. Richard gives a short, well illustrated description of various welding apparatus, including the Thompson machine for making chains, of which also a number of details are given, a Thompson machine for shaping metals, and for making projectiles.

Physiological Effects of High Frequency Currents.—The article by Dr. Hedley from the "Lancet," mentioned in the Digest last week, is given in the Lond. "Elec. Rev.," Dec. 22.

The Boston Motor.

The popularity of small motors is increasing, not only through the interest taken in electrical matters by amateurs, but also for use in driving ventilating and cooling fans in the summer time. The Boston Motor Company, 17 Batterymarch street, Boston, Mass., has recently made several improvements in the Boston motor and battery outfit, which is

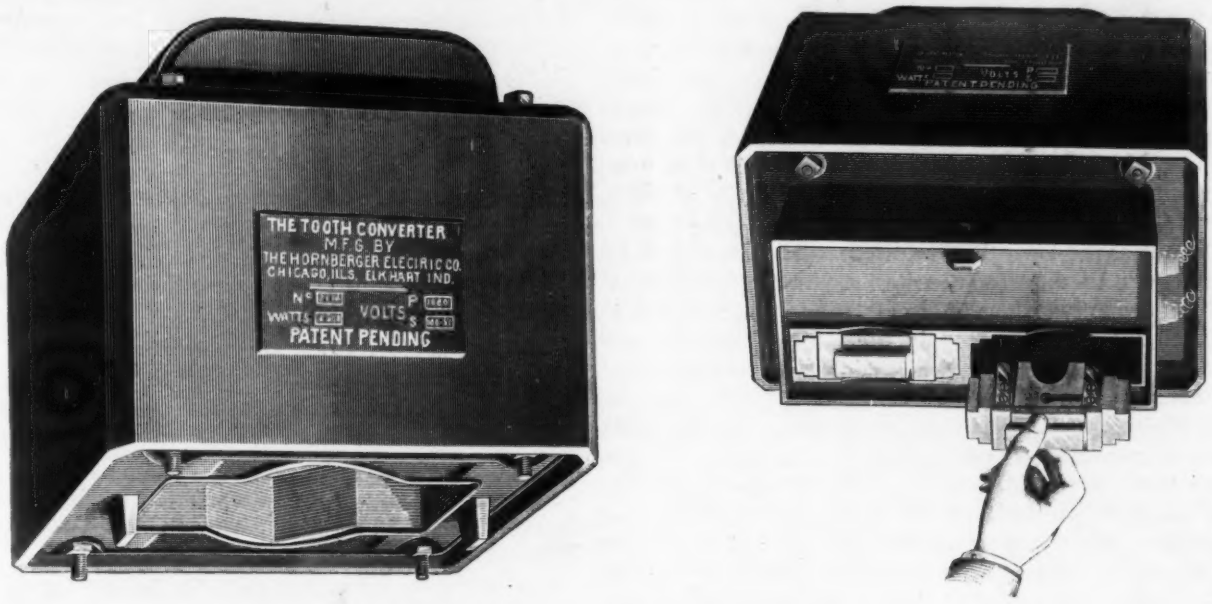


THE BOSTON MOTOR.

one of the best known for these purposes. They are similar in form to the original machine, which was described in The Electrical World of June 24, 1893, but the base is made in one piece, of a durable and highly finished material like hard rubber, manufactured by the Duranoid Manufacturing Company, of Newark, N. J., which is much better than the wood base and iron frame first used. While the motor is small in size, yet, unlike such motors ordinarily, it is efficient in operation, and particular attention has been paid to mechanical details.

The Elkhart Converter.

The converter which we illustrate has been on the market for some four years, and is in use in over 500 central stations throughout the United States and Canada, but is here described for the first time, it having been the policy of the manufacturers, the Hornberger Electric Manufacturing Company, of Elkhart, Ind., to let their apparatus speak for itself, rather than proclaim its merits loudly in print.



FIGS. 1 AND 3.--ELKHART CONVERTER.

Referring to the illustrations, Fig. 1 represents the case with the coil removed. Fig. 2 shows the coil with the cores placed in position ready to insert into the case, and Fig. 3 shows the arrangement of the primary fusing device, which is made of porcelain, and, as may be seen, is unusually convenient for the operation of replacing a fuse, which may be done by a lineman on the darkest night without tools. The fuse case forms the bottom of the converter case, and is closed by a sliding lid.

It will be readily seen that in case of any accident to the coil it may be easily removed by withdrawing it with the core from the case, and that in rewinding it is not necessary to interfere with the laminations of the core as in other forms.

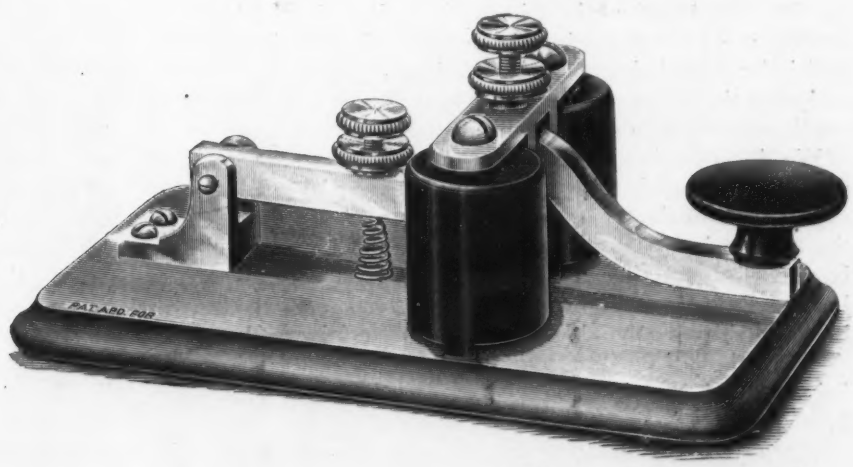
The secondary coils of these converters are multiple-wound, thus allowing connections to be made for secondary voltages of 50 or 100 volts, as may be desired. To place the converter in position, it is unnecessary to use bolts of any sort, as the case is suspended from a forged hook, which is placed in a permanent position on the pole or building, and is adapted to receive and support any converter manufactured by this company.

While the patents of the inventor, Mr. William H. Hornberger, are broad and cover every portion of their device, the manufacturers have not neglected the mechanical features, and lay especial claim to excellent workmanship and minute attention to all mechanical details, which the success they have met with has shown to be abundantly justified.

FIG. 2.--ELKHART CONVERTER.

A Mechanical Telegraph Key.

We illustrate a neat mechanical telegraph key for learners, manufactured by The E. S. Greeley & Company, 7 Dey street, New York, which requires no battery whatever. As far as external appearances are concerned, the apparatus is an



MECHANICAL TELEGRAPH KEY.

exact copy of a regulation key and sounder, having a complete set of adjustments. It is provided with special resonators that give the correct sounder click to the instrument.

New Books.

HOW TO WIRE BUILDINGS: A Manual of the Art of Interior Wiring. By Augustus Noll, E. E. 162 pages, illustrated. Price, $1.50.

A practical book on the methods and details of incandescent wiring is much needed, particularly one giving plans for buildings of different kinds, with actual calculations of wiring, based upon these or upon a typical plan. While the author does give plans of wiring, their practical application—and to show this should be the main object of a book of this character—is not indicated with reference to typical cases, and the calculation of wiring is relegated to chapters in which they are treated with no reference to an actual wiring plan.

We do not agree with the author that "the most general and satisfactory method (of distribution of drop) is, assuming the loss to be five per cent., to allow one-half per cent. in the lamp circuit, one per cent. in the floor mains, one and one-half per cent. in the vertical mains, and two per cent. in the main feeders." On the contrary, by having the greater percentage of loss in the small wires, the variation in drop is in general less; with a large percentage of drop in the large wires a considerable variation in the number of lights in one part of the system will largely affect all the other lights, while in the reverse case different parts of the system will be to a great extent independent of each other in this respect. Even if the rule laid down were not open to this criticism, it would still be unsatisfactory on account of being a mere rough approximation that would not give the best distribution in any case. It is not a difficult matter to calculate the conductors on the assumption that all lead back to the dynamo or primary distributing point, beginning with the branches and ending with the feeders; the operations are simple, and as the normal current in each wire can be thus considered, a nearly perfect distribution of drop may be obtained, while the additional time required by this method of calculation would ordinarily have no practical significance.

The extraordinary feature in the author's method of calculating the area of conductors, is, that he bases it upon the hot resistance of lamps! As the ordinary formula for determining the area of conductors is so extremely simple the reason for the introduction of this absurd factor, which has to be separately calculated—though in what way is not stated—is inexplicable. We venture to say that on account of the involved explanations in this portion of the book, divorced as they are from the principles concerned, the wireman will find it far from being as simple as it was evidently intended, and even the advanced electrician may find it more laborious reading than some chapters in Maxwell.

We do not coincide in the author's advice to the practical wireman to "confine his studies to a general knowledge of electricity sufficient to enable him to trace the direction of the current in dynamos, motors and appurtenances and also in wires"—partly because we see no reason why he should be thus limited, partly because a wireman or no one else will be enabled by a general knowledge of electricity to thus trace the direction of current, and principally because the knowledge would be of absolutely no practical use even if attained. Nor do we agree with the statements that "with proper care the generating apparatus, its appurtenances, wire appliances and fixtures will not depreciate to any considerable extent," and "therefore the cost of maintenance will consist chiefly in the amount of fuel necessary for generating current and the renewal of lamps." Labor and depreciation are items that cannot thus be summarily dismissed. Nor can we see, without qualification, that "the renewal of lamps depends largely on the breakage due to the action of excessive current."

The preface of the book cautions us against being misled by theories, and this advice should be strongly borne in mind by the reader in the portion where the author "drops into theory," as the following examples illustrate: "Ampere is that current having an electric pressure of one volt which flows through a wire having a resistance of one ohm." "To ascertain the available current in amperes, *not generated at the dynamo*, but for consumption by or in the lamps, the resistance of the conductors must be added to the internal resistance of the dynamo." "The term difference of potential denotes that portion of the electromotive force which exists at, or between, any two points in a circuit, and equals the electromotive force (in a dynamo) at the point where the armature 'cuts' the lines of force, minus the amount lost in transmission, due to the resistance of the conductors." "The term 'electromotive force' is generally used to de note the pressure at the highest pressure point; in all other parts of the circuit the pressure is noted as the potential difference, or difference of potential."

A table is given of the safe carrying capacity of conductors as "a safe practical guide," but, unfortunately, as it gives a larger capacity for wires than the Underwriters' rules will permit, it is worse than useless.

While the book is thus far from complying with the requirements of a work of the character which it purports to represent, yet it will be found useful to the wireman in the absence of a better. Much practical information is scattered throughout its pages, and hints for laying out wiring may be obtained from some of the plans of distribution.

THEORETICAL ELEMENTS OF ELECTRO-DYNAMIC MACHINERY. By A. E. Kennelly. Vol. I. New York: D. Van Nostrand Company. 1893. 87 pages, 37 illustrations. Price, $1.50.

The object of this work, as stated by the author in the preface, is to develop for students of electrical engineering the applied arithmetical theory of electro-magnetism, as distinguished from the purely mathematical theory. While the present volume merely opens up the subject, the groundwork of electro-magnetic theory is laid, in which respect the book may be considered as complete in itself. Mathematics are avoided as much as possible, many of the equations that appear being merely formulas for numerical substitution.

In Chapter I. the fundamental principles of magnetic flux are considered and Chapter II. deals with magneto-motive force and potential. The treatment of magneto-motive force in the latter chapter is particularly satisfactory, and will go a long way toward dispelling the mystery often associated in the minds of students with the formula by which it is represented. The numerical examples here and elsewhere throughout the book are especially helpful in assisting to a grasp of the principles developed, and the same may be said of the numerous accurately plotted curves. Chapter III. is on resistance and permeance and points out the analogy of the magnetic with the electric current, at the same time showing the limits of the analogy in practical application, owing to the fact that there is no known magnetic insulator. Chapter IV. relates to the influence of iron in and on the magnetic circuit, in which the effect of air gaps in magnetic circuits is particularly clearly treated. The last two chapters, on stress distribution and on electro-magnetic energy, are extremely suggestive and in accordance with the latest views, which are turning more and more toward the conceptions of Faraday and Maxwell.

To the student and electrician who wish to obtain exact ideas on the principles underlying dynamo designs, this book will prove of great value, while the general electrical student will find it an easily read introduction to the mathematical treatises of Maxwell, Gray and others.

Financial Intelligence.

The Electrical Stock Market.

NEW YORK, Jan. 8, 1894.

THE ELECTRICAL STOCK MARKET did not open in a Happy New Year fashion, but with other industrials started the new year in a grand slump. It was but for one day, however, for on Wednesday electrical securities took an upward turn, and the rise was of such a healthy sort that on the closing day electrical stocks were several points above the closing prices of the week previous. The advance was due to the recovery from a scare based on some discouraging rumors, and the consequent better feeling and activity when there was found to be no reason for fright. Electrical stocks seem to be on the upward move, though still quoted at extremely low figures.

GENERAL ELECTRIC STOCK dropped to one of the lowest figures it has ever been quoted, on the opening day of the market. It was on the confirmation of the news of the removal of the main offices and store room to Schenectady, which was taken as a confession of the weak financial condition of the company. The decline of the other industrials also pulled the stock down. But it went up on a rising wave the next few days and made a gain of one point over last week's closing at the end of the week. The moving of the headquarters to Schenectady, as announced in these columns, though showing the straits the company is driven into, may have a wholesome effect on the stock in the end. When it is shown that the General Electric people are attending more to their manufacturing interests than stock manipulations, the security may have more value on Wall Street. From the actions of the company it is evident that economy is now rigidly entering all the company's management. A number of the executive department and several district agents have been dismissed. It looks as if Drexel, Morgan & Co. (who are now said to be the ruling factor) intend to run affairs on a strictly business basis. The stock is now quoted at 34 1-2 bid and 35 asked.

THE WESTINGHOUSE ELECTRIC COMPANY has declared a semi-annual dividend of 2 1-2 per cent. on its preferred stock, payable January 10. This shows the company is holding its own in the business world and has good financial management back of it. Reports continue of more work and bright business prospects at the Pittsburg plant. The common stock is now rated at 23 1-2 bid and the preferred 41.

THE EDISON ELECTRIC ILLUMINATING COMPANY'S stock does not seem to be traded in extensively nowadays, there being few transactions in it during the week. The company has declared a quarterly dividend of 1 1-2 per cent. on the capital stock, payable Feb. 1. Though the stock has not made any advances during the week, it is still strong, and is ranging around par. The annual meeting of the stockholders of the company will be held Jan. 16 for the election of thirteen directors, to serve for the ensuing year, and other business that may come before the meeting.

WESTERN UNION TELEGRAPH has made a gain of 3 3-8 points during the week, and is now up to 86. There was the usual number of heavy transactions in the stock, and it looks as if the security was now on the bull side.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co. pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	96	99
" " " 1sts	—	103	104
Edison Electric Ill., Brooklyn	100	99	102
" " " Boston	100	115	120
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	—	2½	5
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	5	9
General Electric Company	100	34½	35
" " deb. 5's	—	71	72
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	23½	24½
" " " pfd	50	41	43
Western Union Telegraph	—	86	86¼

New Incorporations.

CANISTEO, STEUBEN COUNTY, N. Y.—The New York State Electric Company has been incorporated to manufacture electric supplies. Melshor Eckstromer and Peter Hanlon, of Canisteo, are interested.

THE SOLDIERS' GROVE ELECTRIC COMPANY, Soldiers' Grove, Wis., capital stock $1,500, has been formed by A. Paterson, M. B. Seward and F. P. Briggs, to build and operate an electric plant in that town.

THE CHICAGO RECORDING SCALE COMPANY, Chicago, Ill., capital stock $50,000, has been formed to make and sell electrical machinery, other machinery, recording scales, etc. The promoters are H. S. Clark, C. C. Russell and E. H. Anets.

THE MANHATTAN ELECTRIC EQUIPMENT COMPANY, Chicago, Ill., capital stock $1,000, has been formed to erect electric plants for various purposes. J. M. Troit, Wm. Frederickson and L. A. Dickey are the promoters.

THE SIDNEY POWER COMPANY, Salem, Ore., capital stock $50,000, has been formed to erect and operate a plant for generating and transmitting electricity. J. M. Wallace, J. M. Kyle and H. T. Wallace, all of Salem, are interested.

THE STEPHENSON ELECTRIC BELT COMPANY, Stromsburg, Neb., capital stock $25,000, has been formed to manufacture and sell the Stephenson electric belt. J. B. Buckley, P. T. Buckley, J. A. Frawley, G. S. Osborne and W. A. Post are the promoters.

THE MORRISON'S COVE ELECTRIC RAILWAY COMPANY, Morrisons, Pa., capital stock $175,000, has been formed to construct and operate an electric railway. S. A. Hamilton, Roaring Spring; I. S. Mock, Ore Hill, and J. P. Jacobs, Hollidaysburg, Pa., are the organizers.

THE M'MILLAN MILL AND POWDER COMPANY OF NESHONOC, Neshonoc, Wis., capital stock $100,000, has been formed to manitain an electric light plant, etc., at that place. S. D. McMillan, D. McMillan, J. K. Johnson and J. W. Ranney are the interested parties.

THE UNITED STATES WENSTROM ELECTRIC COMPANY, Jersey City, N. J., capital stock $30,000, has been formed to manufacture, buy, sell and lease dynamos, motors, etc. B. Blum, C. S. Cowan, New York City, and J. B. De Lery, South Lakewood, N. J., are the organizers.

THE FULLER INCANDESCENT HEAT LIGHT COMPANY, Chicago, Ill., capital stock $1,000,000, has been formed to purchase patent rights, generators and motors for generating electricity, etc. The interested parties are J. T. Kretzinger, C. E. V. Akerburg and M. F. Gallagher.

THE UNIVERSAL ELECTRIC HEAT LIGHT COMPANY, Chicago, Ill., capital stock $100,000, has been formed to purchase sell and operate, patent rights, generators, motors, etc., for generating electricity. The promoters are J. T. Kretzinger, C. E. V. Akerberg and M. F. Gallagher.

CHICAGO, ILL.—The Fogerty Gas and Chemical Company, $10,000,000, Ambrose A. Worsley, H. N. Nanchette and C. J. Satterlee, has been incorporated to manufacture gas under certain patents issued to manufacturers in the East. The process involves the use of electricity, and in consequence the company will erect, or acquire plants for the generating of electric power on a large scale, with a view to supplying electricity to the public, as well as for their own acquirements. H. N. Nanchette, of 172 Washington street, will give details.

THE NEW DECATUR (ALABAMA) NATURAL GAS, PETROLEUM AND MINING COMPANY, Freehold, N. J., capital stock $100,000, has been formed to manufacture, buy and sell, etc., machinery, generators, motors, pipes, etc., apparatus, supplies, and articles of every kind appertaining to or in any wise connected with the production, use, distribution, etc., of electricity, natural gas, petroleum, etc. Thomas Butter, James Swann C. Y. Kent, of New York City; A. Hartshorn, Freehold, and J. D. Probst, Englewood, N. J., are interested.

Special Correspondence.

New York Notes.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Jan. 8, 1894.

THE NASSAU ELECTRICAL COMPANY has filed a claim with the Comptroller of $392.80 for loss of electrical goods which the company alleges were stolen from their offices by city firemen on duty at a fire in the Cornell Building, 137 Centre street, on Dec. 2.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, has begun suit in the United States Circuit Court against the Chicago and West Michigan Railway for infringement of the Sewall coupler patents. The infringement consists of using an imitation of the Sewall steam coupling recently put upon the market. Such railway is the first to continue the use of the imitation coupler after proper notification, and the Consolidated Car Heating Company at once determined to take action to protect the patents issued to Messrs. D. D. & J. H. Sewall.

GEORGE WESTINGHOUSE, Jr., has acquired absolute control of the Westinghouse Machine Company, one of the most profitable of the several Pittsburg corporations comprising the Westinghouse industries, by purchasing outright Ralph Bagaley's stock in the company. The transaction involved 2,000 shares of the stock, and the price approximated $50 a share, or $100,000. Mr. Westinghouse's holdings now amount to nine-tenths of the company's stock. Ralph Bagaley has been identified with the company since its organization in an official capacity as treasurer and general manager.

THE BROOKLYN "EAGLE" says that within the last week one of the political electric light companies has been putting up 175 lights on the streets. When its officials were asked why they were putting up so many all at once, the answer was frankly returned: "Well, as we have been drawing pay for them for a long time it was thought better to have them up before Schieren got in." When again asked where they got the power to supply the lights, their own plant being admittedly inadequate, the rejoinder was: "We propose to hire the power from the Excelsior company." If there had been no change voted last November, the pay without the lights would have gone on all the same.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 6, 1894.

THE WINDSOR LOCKS Electric Light station has just installed a 250-h. p. engine.

THE EDDY ELECTRICAL WORKS, at Windsor, Conn., have started up again on six hours' time.

MAYOR WARDEN, of Waltham, Mass., recommends that all electric wires in that city be put underground.

THE DIRECTORS of the Consolidated Street Railway Company, at Worcester, Mass., voted to issue bonds to the amount of $500,000 to cover the company's floating indebtedness.

CONSIDERABLE ATTENTION is paid by the mayors of the different municipalities in this vicinity to their recommendations in regard to street lighting. The mayor of Newton, Mass., recommends a municipal plant, while the mayors of Waltham and Malden deem it inadvisable to their cities to operate their own plants.

THE NEW ENGLAND TELEPHONE COMPANY is completely revolutionizing its service in Newton, Mass. All the main lines in Newton proper are soon to be put underground, and ultimately all the poles in the city will be removed. The wires on Centre street, from the Watertown line to Sargent street, a distance of over a mile, are already underground.

THE "INVESTMENT EDITOR," of the Boston "Advertiser," in reply to a question about the New England Street Railway, asking if it is going to pass its dividend and whether the enquirer should sell at present prices, replies that he understands that the dividend is to be passed, at which he is not at all surprised, for the reason that the corporation is very much inflated and a good thing to keep clear of unless one is on the inside.

IT IS RUMORED that a foreign electric concern is negotiating for the purchase of the factories of the General Electric Company, at Lynn. Though nothing authentic can be learned from the officials of the company here, or at Lynn, the intending purchaser is said to be the Siemens-Halske Electric Company, which is one of the largest electrical concerns in existence, having an immense plant in Germany, besides factories in England and in Chicago.

DIVIDENDS have been declared on the following stocks: American Bell Telephone Company, a regular quarterly dividend of $3 per share, payable Jan. 15; the Boston and Great Falls Power and Electric Light Company, a dividend of $1 per share, payable Jan. 15; the Boston Electric Light Company, a regular quarterly dividend of 2 per cent., payable Jan. 15; the F. E. Belden Mica Mining Company, a monthly dividend, payable Jan. 15; Westinghouse Electrical and Manufacturing Company, a dividend of 3 1-2 per cent. on its preferred stock, payable Jan. 10.

JACOB C. ROGERS, president of the Edison Electric Illuminating Company, Boston, corrects the statement made in some of the papers to the effect that the fire in the Globe Theatre was caused by the electric wires in the coat room. The theatre was lighted by the Edison Electric Illuminating Company, and Mr. Cabot, the inspector for the Boston Board of Fire Underwriters, who has examined the premises, gives it as his opinion and authorizes Mr. Rogers to state that the fire was not caused by the electric wires. Moreover, according to the testimony of the employees of the theatre, all the electrical circuits were turned off at the close of the evening performance.

CIRCUIT COURT OF APPEALS, First Circuit—Putman, Nelson and Webb, J. J.—The court rendered a decision dismissing without costs the appeal of the Gamewell Fire Alarm Telegraph Company from the order of Judge Colt, of the Circuit Court, granting an interlocutory injunction restraining it from infringing upon a patent owned by the Municipal Signal Company. The patent was granted June 13, 1876, to Henry Ennis for an invention of a telegraph receiving instrument, and it was assigned to the Municipal Company. Before the argument the patent in question expired, and the court says there is nothing remaining for it to decide upon the appeal, as the interculutory injunction appealed from terminated with the expiration of the patent.

MAYOR MATTHEWS, of Boston, in his inaugural address, dwelt considerably on the question of electric street lighting, and pointed out that the electric lights now seen upon the highways have been placed haphazard for the benefit of individual applicants, rather than for the entire community. He complains of the cost as being excessive, considering the number of lights in use. Boston now uses 15,088 electric lights, which cost 40 cents apiece per night, or about $225,000 a year. In comparison with other cities, this price would not seem excessive. New York pays 42 cents per light, Brooklyn 50 cents, Providence 44 cents and Philadelphia 43 cents. This shows that Boston is getting its light more cheaply than the other large cities above quoted. The Boston Electric Light Company furnish the light, and as the demand increases and more lights are ordered it is probable the price per light can be reduced.

THE WASHBURN & MOEN MANUFACTURING COMPANY on Jan. 1 sent the following circular to the salaried men in their employ: "Owing to the continued uncertainty in business, the directors deem it necessary to make a general reduction in the salaries of the officers and salaried employes of the company. Salaries less than $2,000, 10 per cent.; from $2,000 to $2,500, 15 per cent.; $3,500 and over, 20 per cent.; to take effect Jan. 1, 1894. With decreased production, the earnings of the company, as well as its dividends, have been materially diminished and wages have been reduced. It is expected that all having salary contracts will cheerfully acquiesce in this action of the directors, in order that every one may share in the burden due to existing business conditions. The general manager is instructed to carry this action into effect." A second circular was sent out to stockholders as follows: "Believing that the unstable condition of general business renders conservative action desirable, your directors have decided to declare a quarterly dividend of $1 a share, payable on this date." Last quarter the dividend was 2 per cent., and for a number of years previous 3 per cent. a quarter has been regularly declared. The stockholders the past year absorbed $1,000,000 of new stock at par.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, CHICAGO, Jan. 6, 1894.

MR. WALKER C. MCKINLOCK, secretary of the Metropolitan Electric Company, Chicago, has just returned from a successful business trip and reports the outlook for his new company as very promising.

THE WESTERN ELECTRIC COMPANY open the new year with great activity in their electric lighting department. At present they are employed in perfecting arrangements for the lighting of the Mid-Winter Exposition at San Francisco, for which they have a contract.

THE CENTRAL ELECTRIC COMPANY will commence 1894 on the floodtide of prosperity. Notwithstanding the distressing times and the present unsettled condition of the supply business in the West, the Central goes right on increasing its business week by week. Mr. George McKinlock is still at the helm.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY has opened an office at 1,536 Monadnock Block, under the charge of Mr. G. W. Conover. The business of this company is increasing in volume every day. It will carry a large stock of its goods at the Chicago branch, from which all orders can be filled promptly.

THE COMPLETE ELECTRIC CONSTRUCTION COMPANY, whose home office is in New York, has opened a Western office at 1,401 Monadnock, Chicago, and placed Mr. Clift Wise in charge. Mr. Wise is well known to the fraternity, and is meeting with a cordial welcome in the West.

THE WASHINGTON ELECTRIC COMPANY is now shipping many of its new alternating current arc lamps, about which so much has been said. This lamp is destined to meet with popular favor on account of its extreme simplicity. The works are at 197 South Canal street. President Stein promises to become a notable figure in future electrical assemblages.

C. M. SPAULDING, who was first introduced to the electrical fraternity through his connection with the Leonard & Izard Company, of Chicago, and who was only recently connected with the Ansonia company, has been appointed Deputy Collector by Internal Revenue Collector Mize. A host of friends, including The Electrical World, extend congratulations.

THE STANDARD ELECTRIC COMPANY is among the most successful firms in the West, judged by the record of 1893. Its arc lighting apparatus has met with success wherever introduced, and was one of the most conspicuous at the World's Fair, both in Electricity Building and Machinery Hall. This apparatus is now favorably known in all sections of the country, and its prospects for 1894 are of the brightest.

THE GREAT WESTERN MANUFACTURING COMPANY, the organization of which was perfected a little more than a year ago, finds itself on its first anniversary one of the leading electrical manufacturing concerns in the country. Its very complete works at Duluth are particularly busy just now turning out apparatus for some of the handsomest orders placed in the last six months. It now has on hand orders for arc, incandescent, alternating and power generators.

CHARLES SORLEY, for so many years one of the leading storage battery experts in the United States, and more recently of the Pumpelly-Sorley Storage Battery Company, has opened an office on his own account at 1,563 Monadnock. Mr. Sorley will

give expert advice on the handling of storage batteries, and will guarantee to insure the successful operation of any existing storage battery plant, no matter what type of cell is used. He has the best wishes of a host of friends for his success.

GOODHUE & LINCOLN, although a newly organized firm, with offices in the Monadnock, have secured some very satisfactory contracts, among others a three-thousand light capacity transformer order. Mr. Goodhue has had a long experience in handling transformers, and has made some very large sales in the past. Associated with him is Mr. Lincoln, a bright and enterprising young business man. They expect, and have every reason to receive, a cordial New Year's reception from the electrical fraternity.

GEORGE G. CARTER & COMPANY.—Although this firm started in business in one of the worst months of the worst years for business in twenty years, it is doing remarkably well with the lines it handles. It now adds a new and very valuable name to its list, an incandescent lamp to be known as the "Anchor" lamp. Already it has sold a large quantity of these, although its announcements have heretofore been confined to correspondence. It commences the new year with the brightest prospects of success.

D. C. SPRUANCE, of the Helios Electric Company, enjoys the distinction of having made the largest purchase of rubber covered wire in history. He has just been successful in purchasing from the World's Fair all the wire used in their electrical work, amounting to about 600,000 pounds of Safety Grimshaw, Okonite and E. M. W. Mr. Spruance has established headquarters at the Auditorium Hotel, Chicago, from which point he will handle this gigantic deal. The wire is now for sale on the market, and can be had cheap.

THE ELECTRIC APPLIANCE COMPANY has been having a particularly Merry Christmas, principally on account of the fact that by hard hustling it was able to get its entire trade supplied with copies of the latest edition of its catalogue, and for the past week the company has been in receipt of numerous congratulatory letters complimenting the completeness, attractive appearance and intelligent arrangement of the work. A great many of the letters were accompanied with a substantial proof of appreciation, in the shape of large orders for material selected from the new book.

THE BROWN TELEPHONE AND TELEGRAPH COMPANY, of the Manhattan Building, announce that Feb. 1 it will place on the market its perfected Magneto telephone, which will be absolutely free from patent contention. Some of these instruments have been in successful operation over many miles of territory, and as they are exceedingly simple and effective will no doubt have a wide sale. S. W. Groesbeck is president of the company, George W. Wilson, secretary, and Thomas H. Murray general manager. Inventor Brown is vice president and electrician.

G. W. CONOVER, who has been well known in Western electrical circles for many years as purchasing agent of the Ansonia Electric Company, has resigned from that position to become Western manager for the Perkins Electric Switch Manufacturing Company, of Hartford, Conn. He will make his headquarters at 1,536 Monadnock Block, where he has already fitted up a comfortable office. Mr. Conover has a wide acquaintance among electrical men, and, judging by his experience and success with the Ansonia Company, the results of his work in his new position will be very gratifying, not only to himself and his friends, but to his company.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, of 301-303 The Rookery, announces that with the commencement of February, 1894, it will supply magneto telephones that will in no way infringe the group of telephone patents which has heretofore made a monopoly of the business possible. This concern has become widely and favorably known, by reason of its automatic telephone exchange, introduced to the public more than a year ago at La Porte. It has been in continuous operation at this place since its installation, and has worked so successfully that existing telephone interests have offered to buy it. Licenses have been granted for the introduction of this system in nearly every State in the Union, and contracts have been closed for the equipment of many central telephone stations, as well as a host of private and commercial systems. The continued success of this automatic exchange will be of the greatest value to telephone service, and there is every reason to believe that the year 1894 will see its introduction on a surprising scale.

WALTER CAMPBELL, president of the Illinois Electrical Forging Company, has disappeared, and many stockholders in the alleged company, whose subscriptions amount together to $215,000, are looking for him. The Boston Electrical Forging Company, well known in the East, had an exhibit at the World's Fair of a method of welding metals by means of electricity, and Campbell secured State rights of the patent for Illinois. Under the terms of the negotiation with the Boston firm the latter was to receive 25 per cent. of th stock in the new concern, for the Illinois right. Campbell himself was to be the principal stockholder, his claim being 50 per cent. of the stock. He managed to collect altogether over $100,000, while the company was being formed. Among those whom he has swindled are President Bush, of the Bank of Yolo, Woodland County, Cal., who purchased stock to the value of $20,000; H. J. Thompson, of Chicago, $10,000; Oliver Rice, Lewiston, Ill., $20,000. While at Lewiston, Campbell induced a merchant named Phelps and his son William to pay $115,000 in notes for the worthless stock. From Lewiston Campbell went East, where he successfully discounted the notes given for something over $100,000. Since then nothing is known of his movements.

OREGON CITY, Jan. 2, 1894.

PORT ANGELES, WASH.—The contract for an electric light plant has been let to W. C. Williams, who will take $37,000 in city bonds for his pay.

O. A. PETERSON, railway constructing engineer, with the General Electric Company, late of Lynn, Mass., recently visited the Portland General Electric Company's water power station in Oregon City, while on his way to San Francisco.

Canadian Notes.

OTTAWA, Jan. 6, 1894.

VANLEEK HILL, ONT.—The Vanleek Hill Electric Light Company, whose capital stock was recently increased to $10,000, is erecting a fine new power house, in which they have placed a 60-h. p. engine, three large dynamos and a generator.

HAMILTON.—The city clerk has received a check from the street railway for the amount due for the past quarter under the by-law. The amount was $3,065, made up as follows: 6 per cent. on gross earnings, $1,622; mileage, $1,443. The total amount received for the past year was $12,504; over $500 above the estimate.

TORONTO.—The revenue of the street railway during 1893 was $902,927, of which $72,234 went to the city in the form of percentages. The city's share for December was $5,539, as compared with $5,621 during December, 1892. Last year the earnings of the company were $815,492, and the city's share $65,239. It is expected that the earnings of 1894 will reach the million mark.

THE RELIANCE ELECTRIC LIGHT COMPANY, Toronto, have apprised the City Engineer that they expect to receive concessions from the city similar to those enjoyed by other lighting corporations, unless the exclusive right to light Parkdale is granted, when they would be prepared to pay for the franchise. Mr. Wright, of the Toronto Electric Light Company, in a communication, says that his company will insist upon the right to erect poles if the Reliance Company is granted permission to do so.

TORONTO.—Notice is given that application will be made to the Legislative Assembly of Ontario, next session, for an act to incorporate a street railway company to be known as the "Toronto Suburban Railway Company," with power to take over and acquire all the assets, rights and franchises of "The City and Suburban Electric Railway Company (Limited)" and "The Davenport Street Railway Company (Limited)" and to issue paid-up stock in payment therefor, and to assume the liabilities of the same; with power also to acquire other franchises. The capital stock of the company to be fixed at the sum of $250,000, divided into 2,500 shares of $100 each.

WINDSOR, ONT.—A company has been formed to build an electric railway from Windsor to Amherstburg, to be known as the Detroit, Windsor and Amherstburg Railway. Application for a charter will be made at the approaching session of the Ontario Legislature. The capital stock will be $300,000, and the provisional directors will be Colonel James M. Clarke and William McGregor, M. P., of Windsor; Mayor J. G. Mullen, John A. Auld, J. David Burk and William D. Balfour, M. P., of Amherstburg. The Sandwich, Windsor and Amherstburg Railway Company have a charter, but as they have made no move to extend their line toward Amherstburg, the new company propose to take hold of the matter and organize as soon as their charter passes the Legislature.

English Notes.

(From our own Correspondent.)

LONDON, Dec. 27, 1893.

ELECTRIC TRACTION AT WALSALL.—According to a recent report, the overhead trolley system of electric traction at Walsall has led to a 20 per cent. increase of traffic in the past twelve months.

THE GOVERNMENT AND THE TELEPHONES.—The long delayed draft of the agreement between the Post Office and the National Telephone Company still continues to hang fire, and it is now stated that there is no prospect of the agreement being laid on the table of the House of Commons this session.

CENTRAL STATIONS IN CROWDED CITIES.—The St. James and Pall Mall Company, by the frequent legal actions which it is involved in, is experiencing one of the drawbacks of having a genuine central station. The latest action with which it is threatened is by the St. James vestry, who propose to prosecute it for discharging hot water and steam into sewers, and for being a source of bad smells.

ELECTRICAL RAILWAY ENTERPRISE IN LONDON.—In a recent letter, I mentioned that electric enterprise in London had

been at a complete standstill for some little time; no new schemes being formulated, and the ones which had obtained Parliamentary sanction having dropped into oblivion. The directors of the Exploration Company (Limited) in their report for the present year, state, in connection with the Central London Railway, in the promotion of which they are interested, that everything is ready for the carrying out of the scheme, with the exception of the necessary money, which it has been impossible to obtain, owing to the unfavorable state of the money market.

TOWN COUNCILS AND FREE LUNCHEONS.—The treating, which has been going on for some time past, of the members of the Electric Light committees of town councils by expectant electric light contractors, has, I am glad to say, met with a slight check. At a recent meeting of the York Town Council, a protest was made by one or two members against some recent visits made to electric light works by a sub-committee of the council at the expense of some electrical firms. It was remarked that after having been four years amassing information the sub-committee was still not content, and were not, as might have been expected, "above being feasted with the not very distant object in view of those who feasted them obtaining some advantage." A formal resolution was finally moved stating that all such expenses must in future be paid out of the city rates.

News of the Week.

Electric Light and Power.

ALLIANCE, O., will have a new electric light plant in the near future.

GRAND JUNCTION, Ia., is contemplating seriously the question of electric lights.

WACO, TEX.—W. W. Larmour is in the market for an electric elevator for an office building.

CANTON, O., has resolved to ask legislative authority to issue bonds for a $60,000 electric light plant.

BUTTE, MONT.—Proposals are wanted to Jan. 17 for furnishing an electric plant for the public library.

ST. PARIS, O.—An electric light petition is being circulated and the prospects are good for securing a plant.

SCHENECTADY, N. Y.—The Lamp Committee has advertised for proposals for lighting the city, to be in by Jan. 9.

LARCHMONT, N. Y.—An electric light plant will be established and be in operation next summer. It will be a local corporation.

BRUNSWICK, MO.—An election will be held Jan. 13 to vote in the matter of issuing $10,000 in bonds for an electric lighting plant.

DETROIT, MICH.—The public lighting board will receive bids for building the new lighting station Jan. 23, and for the machinery Jan. 30.

SAUGATUCK business men are contemplating the establishment of an electric lighting plant large enough to light the stores of the town.

ROCK FALLS, ILL.—The City Council of Rock Falls rejected all bids for the proposed electric light plant, on the ground that they were too high.

PHILADELPHIA, PA.—The "Record" states that Mayor Stuart is anxious to make his administration notable for electric lighting and improved streets.

HAVERHILL, MASS.—The Board of Aldermen has unanimously passed an order for the establishment of a municipal electric light system.

TOLEDO, IA.—The town council has decided to hold a special election Jan. 11, for the purpose of deciding whether the town shall be lighted by electricity.

DETROIT, MICH.—P. L. Chappton, of 245 Woodward avenue, is architect for the proposed incandescent light station to be built at Michigan avenue, near Fifteenth street.

EASTON, PA.—Councilmen have received with favor, but not passed officially, a suggestion for a bond issue, to pay for an extra dynamo, as well as other necessaries.

HUDSON, N. Y.—On motion of Supervisor Duntz, a committee of three was appointed to look into the matter of an electric lighting plant for the county building at Hudson.

RICHMOND, VA.—The resolution of Mr. Murphy authorizing an issue of $75,000 in 4 per cent. bonds for an electric lighting plant has been referred to the Finance Committee.

DETROIT, MICH.—The Public Lighting Commissioners have decided to accept the plans and specifications of Architect John Scott, and they will receive bids to January 23.

GRISWOLD, IA.—It is proposed to put in an engine with the water works plant, powerful enough to operate an electric plant in connection with the water works system.

BRUNSWICK, MO., will vote on Jan. 13 as to whether the city shall become indebted in the sum of $10,000 for the construction and erection of a system of water works and electric lights.

HAVERHILL, MASS.—The Common Council has refused to concur with the Mayor and Aldermen in the passage of an act favorable to the establishment of a municipal electric light plant.

ABERDEEN, MD., will be lighted by electricity, and is also subscribing $30,000 toward the capital stock of an electric road from that place to Glenville and the Susquehanna paper mills.

BATAVIA, N. Y.—The Board of Aldermen of Batavia have decided to require contractors to furnish dynamos of the capacity of 120 lamps of 2,000-c. p. The clerk has been authorized to call for bids.

FALL RIVER, MASS.—In his annual message, Mayor Coughlin states that Fall River is now paying very high for her electric lighting, and that it would be good policy for the city to begin now and prepare for owning her own plant.

ROCHESTER, MINN.—The electric light plant at Sleepy Eye is owned and controlled by the city. In November, the total expense of running the plant was $177 and the amount received from rentals $200, leaving a balance in favor of the city.

ROMEO, MICH.—E. P. Kinney, a Detroit electrician, will put in an electric lighting plant at Romeo if the citizens will take $700 worth of the stock. This has been assured, and all that is neceeded now is a five years' franchise from the village.

CAMBRIDGE, MASS.—The Cambridge Gaslight Company and the Cambridge Electric Light Company have been requested to file with the city authorities a complete statement of their plants to guide the authorities in the matter of purchasing the same.

ATTLEBORO, MASS.—The electric power station of the Inter-State and Attleboro, North Attleboro and Wrentham Electric Street Railways, located at Farmer's, on the Wrentham branch of the consolidated road, was burned with all contents. Loss, $75,000.

WILMINGTON, DEL.—Proposals will be received at the office of the Water Department, southwest corner Sixth and King streets, to Jan. 9 for wiring the city mill filter pumping station for electric lighting, details to be had on application to J. A. Bond, chief engineer.

NEWARK, N. J.—The Harrison Park Water and Supply Company has bought the artesian well plant of the Iron Hall Land and Improvement Company, and they propose to put in a steam pumping plant, which will also furnish power for a village electric lighting system.

YORK, PA., has been making some investigations as to the relative cost of a municipal electric light plant and lighting by contract. The present cost of lighting is $18,000 a year. A committee has reported that a city electric plant can be supplied for $35,000 and operated at a cost of $10,000 a year.

RED BANK, N. J.—Proposals are wanted for lighting the town with sixty or more arc lights of 2,000-c. p., all night, and every night, on a five years' contract. Proposals may include incandescent lights for stores and dwellings. Also cost of plant should town decide to purchase. Address H. H. Curtis, Commissioner.

BELLEFONTE, PA.—The Edison Electric Illuminating Company has received the contract for lighting the streets of Bellefonte for the term of three years with twenty-one arc lights, every night and all night except clear, moonlight nights, at $105 per light per year. Also for fifty 16-c. p. incandescent lamps at $21 per year each.

WILKESBARRE, PA.—Simpson & Watkins are putting in an electric light plant at their Mt. Lookout colliery for the purpose of lighting the mines, and propose furnishing electric light to the borough of Wyoming, if the citizens desire to have it. There is not a town in the whole Wyoming Valley that cannot be supplied with electric lights from the culm waste from the mines. The only wonder is that our mine owners are not utilizing this waste material in the manner indicated.

WINONA, MINN.—Sealed proposals will be received to Feb. 11 for furnishing the city with gas or electric lights for street lighting for the period of three, five, seven, or ten years. 1. With arc or incandescent lights, or both. 2. With gas. 3. With arc or incandescent lights, or both, or gas. 4. With arc and incandescent lights, the city to have option of purchasing plant complete after two years, the city to furnish a site. 5. For furnishing a plant for lighting the city with arc or incandescent lights, or both, the city to furnish site, building and power; plans to be completed July 1; proposals will be opened at regular meeting of city council Feb. 11. O. H. Clark is recorder.

The Electric Railway.

DECKERTOWN, N. J., wants an electric railway.

CHARLOTTESVILLE, VA.—An electric street railway seems to be assured.

HOT SPRINGS, ARK.—George W. Baxter is interested in the project to build an incline railway to the summit of West Mountain.

ASHEVILLE, N. C.—The gas plant and railway system of the Asheville Street Railway Company are soon to be enlarged and improved.

BOSTON, MASS.—The West End Street Railway will build their proposed short cut from Boston to Brighton via. North Beacon street to the Watertown line.

BRIDGEPORT, CONN.—The Sanford & Stillman Company of Jersey City, N. J., will be among the bidders for the construction of the lines of the traction company in Bridgeport when the proper time arrives.

ATLANTA, GA.—Mr. Adams, formerly of Corinth, Miss., has succeeded Mr. S. W. Divine in the presidency of the Chattanooga Electric Street Railway Company. Mr. C. P. Young is still the efficient superintendent.

KANSAS CITY, MO.—The Kansas City Electric Railway Company has been granted a franchise to build a line from Summit street to Westport. W. W. Kendall is president of the company and T. S. Case is secretary.

BRISTOL, PA.—The representatives of the company which proposes to build a trolley line in Bristol are conferring with the Borough Council. If their terms are acceded to, they promise to have the line in operation by July 1.

CAMDEN, N. J.—William Thompson, owner of the Gloucester, N. J., race track, has filed incorporation papers of the Manahawkin and Long Branch Transportation Company, to carry passengers and freight between these points. Capital $500,000.

FALLS CHURCH, VA.—The proposition to issue bonds for $10,000 to aid any company that will build an electric railway here meets with much favor and at the next meeting of the Council, the committee will request that the matter be submitted to a vote.

GLOVERSVILLE, N. Y.—The Gloversville "Leader" states positively that a road will be built from Amsterdam to Gloversville and Johnstown, to accommodate both electric and steam motors. No names have yet been mentioned in connection save that of a Mr. Caten, of Gloversville.

TOLEDO, O.—The Toledo and Maumee Valley Railroad Company, capital $300,000, has been incorporated to build a railway, to be operated by electricity, or other motive power, from Toledo to Perrysburg. William B. Taylor and Josiah D. Cook, civil engineer, 47 Produce Exchange, are interested.

BRIDGETON, N. J.—The Bridgeton, Port Norris and Cedarville Railway Company has been granted a franchise. Among those interested are John Smalley, Prof. W. O. Garrison and Walter H. Bacon. Owing to strong remonstrance, the franchise applied for by the West Side Railway was not passed upon finally.

CHESTER, PA.—S. M. Patterson, of the Pennsylvania Traction Company, is seriously considering the advisability of running a branch of the proposed electric railway to Oxford. The idea is to connect it with the main line of the electric railway at Parkesburg, the distance from which place to Oxford is about fifteen miles.

BROCKTON, MASS.—Mayor Whipple, in his inaugural address before the city council, recommends immediate application to the Legislature for adjustment of corporation tax, so that cities may tax the franchises of street railway companies, said tax to compensate for the expense and disadvantages incurred by the cities by location of tracks.

JERSEY CITY, N. J.—By a vote of 8 to 3, the Board of Freeholders of Hudson County have granted a franchise to the Jersey City, Harrison and Kearney Railroad Company to operate a railroad on the Heights and highway from Newark to Jersey City, through Kearney and Harrison, over the New Hackensack bridge, no engine ever to be used on the road.

BROOKLYN, N. Y.—The Highway Commissioners of Flatlands, L. I., have granted a franchise to the Brooklyn, Bergen Beach and Canarsie Railway Company to build eighteen miles of railway there. The line will extend to Bergen Beach, with a branch across country to the Canarsie shore. An electric plant, to cost $30,000, will be erected at Flatbush avenue and King's Highway.

GARDNER, ME.—The electric street railway project here in town is assuming tangible shape, in anticipation of spring, and the beginning of work then. The Selectmen will give a hearing in a few days on final matters in connection with the franchise. There has been enough stock taken to hold the franchise should it be granted, and the rest is pledged. Altogether the outlook is bright indeed.

NEW UTRECHT, L. I., N. Y.—Martin H. White, Commissioner of Highways of New Utrecht, has decided to grant a franchise to the Thirty-ninth Street, Brooklyn, Ferry and Suburban Railway, and to refuse a franchise to the Mapleton, Van Pelt Manor and Bath Beach Railway Company. This action was owing to absence of opposition to the former road, and the strong opposition to the plans of the Mapleton Company.

READING, PA.—The matter of the proposed electric road from Temple to Reading is being discussed, and John H. Rothermal, representing the Reading and Southwestern Street Railway Company, has submitted a proposition, which will be considered. The Reading Traction Company is also in the field, and residents of Muhlenoburg township are considering the matter. The farmers in this township are asking a high price for damages.

CORNING, N. Y.—The Corning "Democrat" calls attention to the fact that a prominent citizen of Corning has offered to furnish the cash capital to build a street railway, if citizens would guarantee him 5 per cent. on his investment, with the understanding that all net income over 5 per cent. should be divided between the company and the capitalist. The "Democrat" urges citizens to take action, and will furnish any additional details.

PITTSBURGH, PA.—The Pittsburgh Elevated Railroad Company, $100,000, has been chartered to build a ten-mile road from Pittsburgh to Wilkinsburgh Borough. John H. Dalzell is president, and the directors are Joshua Rhodes, W. B. Rhodes, G. B. Hill, J. D. Nicholson, R. S. Frazer and A. M. Neeper. The Horthside Elevated Railroad Company, $50,000, was also chartered, with John H. Dalzell as president, and G. B. Hill and Joshua Rhodes as directors. The route of the latter company is not given.

TRENTON, N. J.—A new electrical railway is being projected by Joseph H. Reale, of Bloomfield, N. J., to connect the Delaware and Hudson Railway cities with spurs to take in all the side towns from the mountains to the seashore; the cars are to be double motor of 30-h. p. each, and five electric power plants will be located, one each in Trenton, Rocky Hill, Bound Brook, Westfield and Orange. It is stated that most of the capital has been subscribed and that work will be begun within six months. Among those interested are John H. Reale, of Bloomfield; Charles E. W. Smith, of Morristown, and J, H. Baldwin, of Orange. E. Chamberlain is engineer.

NASHVILLE, TENN.—The United Electric Railway has been placed in the hands of a receiver. This road was formed six years ago by the consolidation of all the street railways then in Nashville and has at present over sixty motor cars in operation and fifty miles of track. The receivers are the Nashville Trust Company and Thomas W. Wrenne, the former president of the road. Owing to the financial stringency of 1893 the road's earnings fell off to over one-half of what they had been in 1892, in which latter year they amounted to $334,000. The road was unable to pay its January interest. It is understood that one of the conditions of the receivership is that the Nashville Trust Company will advance funds to pay off the floating debt and January interest.

FITCHBURG, MASS.—The prospects for electric street railway extension in Worcester County, north, are decidedly better than they were a month ago, for it is evident that the Selectmen of Lancaster are very favorably disposed toward the petioners for leave to run rails in that town in connnection with the Clinton line. The Clinton company is largely owned here, and the local company already owned here, and the local company already has in operation a line extending nearly through Leominster and well over toward Lancaster. Now that the Worcester North Company of Leominster is out of the field, having allowed part of its franchise to expire by limitation, it is more than ever probable that the Fitchburg and Leominster Company will renew its petition for leave to extend its tracks to Lancaster, and, of course, to Clinton, making a valuable and available system, connecting a number of large towns with this city.

THE ATLANTA CONSOLIDATED STREET RAILWAY COMPANY has failed to pay the intrest on its bonded indebtedness, due Jan. 1. The amount of this indebtedness is about $1,833,000, the rate of interest being 6 per cent. per annum. Mr. Joel Hunt, president of the road, has been making every effort to abridge the present trouble and bring about an agreement among the bondholders, which will prevent the appointment of a receiver with its various consequences. It is stated that he has obtained such an agreement, in which the bondholders agree to accept 3 per cent. interest instead of 6 per cent. for two years, after which a rate of 5 per cent. will be adopted. It is necessary for 90 per cent. of the bondholders to agree to this proviso to have it carried out. It is also proposed to assess the stockholders to pay off the floating indebtedness. Such a plan deserves support. The Consolidated is one of the first and finest pieces of electric railway property in the South, and will prove valuable to its stock and bondholders. The recent depression in business has crippled the road's finances, but with the close economy practiced by the road, it will pull through successfully.

CANANDAIGUA, N. Y.—The Littleville plant has been built by the Canandaigua Electric Light and Railroad Company, which is the union of the Canandaigua Electric Light Company and the Canandaigua Street Railway Company. The new company is incorporated with a capital stock of $80,000. The officers are M. D. Munger, president; H. B. Ferguson, secretary and treasurer, and C. J. Purdy, general superintendent. The cost of the plant is about $50,000. To obtain the needed water rights, the company bought 240 acres of farm land, about 150 acres of which will be flooded. It is proposed to light from Littleville, Palmyra, seven miles away; Canandaigua, five miles; Manchester, a mile and a half, and Shortsville, three-quarters of a mile distant. The officers of the company give assurance that an electric street railway will be laid in the spring through Canandaigua over the route of the old horse-car line, and will be put in operation as soon as possible. It is an open secret that the managers of the company propose to construct at an early date a railway from Canandaigua to Shortsville and Manchester, connecting at the latter place with the Lehigh Valley Railroad. This proposed road will carry both coal and passengers. The lamps of Canandaigua, it is expected, will be lighted by the Littleville plant within a month. The old plant will be used for some time yet, but its use will be gradually discontinued, until finally all the power will be centred at Littleville.

AN ELECTRIC RAILWAY, between Boston and Portland, will be built, it is rumored, within the next three years. A syndicate has been formed, and it is understood that Hon. Frank Jones, of Portsmouth, N. H., is a prime mover in developing the rapid transit scheme. The ground has been looked over very carefully, and the line will be located as soon as the civil engineer finishes his survey, which will probably be in a few days. The plan, as it now stands, is to run trains every hour from the terminal cities, and it is expected to make the run from Boston to Portland in four hours. In some parts of the road the rails will be placed on trestlework, some four or five feet above ground. This will be done to make the removal of the snow from the tracks easier. It is understood that Arthur Sewall, late president of the Maine Central road, is also interested in the plan. He is owner of an electric line in New York State, and has the control of some valuable patents which pertain to the storage system. He is a firm believer that electricity will replace steam. What electric roads are operated in Massachusetts and can be used advantageously are now controlled by the syndicate or its friends. This syndicate also has its eye on an electric line in Maine, and here Arthur Sewall's hand in the scheme is shown. He is building the line between Brunswick and Bath, and is interested in other lines which will be consolidated into one line.

Personal.

MR. J. V. Z. ANTHONY, the young and enterprising manager of the Middletown Electric Light and Power Company, Middletown, N. Y. (which concern is under the control of the Fort Wayne Electric Company), was quietly married to Miss Frances James, of Jersey City Heights, on Jan. 4. Miss James is conceded to be the belle of the section wherein she resides, and the young people have the best wishes of their many friends for many years of happiness.

JOHN WALKER is a name which bids fair to become as familiar in electrical circles as it already is in other fields. The recent announcement that the Walker Manufacturing Company, of Cleveland, had decided to engage in the manufacture of electrical machinery was received with the greatest interest, and has created considerable stir among electrical men. Mr. Walker has been closely identified with the company that bears his name, and his engineering skill and executive ability are to a great degree responsible for the magnificent manufacturing plant that has been built up. He has made some important inventions in cable railway apparatus, which are now embodied in almost every modern cable plant. With its past record for high class work, with its splendidly equipped plant and with John Walker as its vice president and general manager, the Walker Manufacturing Company may enter the electrical field confident of success.

Miscellaneous Notes.

NEW ORLEANS, LA.—The newly organized electrical club of New Orleans will have a house fitted with rooms for electrical experimental purposes.

THE NEW YORK ELECTRICAL SOCIETY will hold its next meeting at Columbia College, on Tuesday, Jan. 16, at 8 p. m. Prof. M. I. Pupin will deliver a lecture on "Electrical Resonance," accompanied by experiments, showing the properties and influence of self-induction and capacity on electric circuits.

A NEW CONDUIT SYSTEM.—William T. Dulany, of 280 Broadway, New York, has devised a system of operating street railway cars by a trolley on the underground plan, and has applied to the authorities in Brooklyn for permission to lay underground wires for a distance of one mile, when he will give a public exhibition of his new invention.

AN ELECTRICAL SCHOOL.—G. C. Siebert, an electrical engineer, has started an electrical school at 47 Church street, Montreal. This school fills a long felt want. A thorough knowledge of electricity can be obtained without the time and expense of a McGill course. Mr. Siebert has a thorough knowledge of his subject, both in theory and practice.

ELECTRIC GAMBLING.—Electricity has been applied to a novel use in Birmingham, Ala. R. D. Burnett, of that city, has been arrested for using a dice-throwing device in which electricity was used to manipulate the dice. The current could be turned on from behind the counter or bar by pressure of the foot, and the dice were so constructed as to fall a fixed way when the current was on, the current of course, being turned off while the customer was playing.

UNIVERSITY EXTENSION LECTURES.—Dr. Charles Forbes will deliver a University Extension course of lectures on electricity and its practical applications at Rochester, beginning on Jan. 9. Prof. Arey also started a course of lectures on Jan. 6 at Buffalo, which will cover the forces of nature as related to modern life, the nature of light and heat, music and the development of sound, magnetism, and the applications of electricity.

THE MONTREAL (CANADA) ELECTRIC CLUB has adopted a new constitution and by-laws, which give the following qualifications necessary for membership: Members—Those actively engaged in any branch of the electrical profession, and students in electricity equal to third and fourth years at McGill University. Associates—Business managers of electrical firms, and members of other branches of the engineering profession. Associates to have full club privileges, with the exception of holding office.

THE WESTERN NORMAL COLLEGE, Lincoln, Neb., is building up, under the guidance of Mr. A. M. Craig, a course of electrical engineering, whose aim is to produce judicious workmen rather than technical experts or scientific investigators. It proposes to accomplish this result by requiring every student not only to handle, but to build electrical machinery. Students will be given practice in making castings and trimming and fitting them, in building converters, in winding various styles of armatures and field magnets, and in all parts of dynamo and motor construction. It is hoped in this way to make the education truly practical, and at the same time prevent graduates from making the mistakes so frequently committed by college graduates,

Trade and Industrial Notes.

THE CHICAGO ELECTRIC WIRE COMPANY, Wilmington, Del., received a contract to furnish eighty-four miles of 7-conductor submarine cable for the United States Government, to be used in the torpedo service.

THE PITTSBURG REDUCTION COMPANY has, it is rumored, absorbed the Cowles Electric Smelting and Aluminum Company, whose works will be removed to Niagara Falls, with those of the Pittsburg Company.

THE JONES BROTHERS' ELECTRIC COMPANY, of Cincinnati, O., is making long strides toward procuring its share of the sales of all kinds of electrical supplies, including those for electrical railways. It has just taken an order from the Cincinnati Street Railway Company for fifty miles of trolley wire.

THE BEACON VACUUM PUMP AND ELECTRICAL COMPANY, Irvington street, Boston, has issued a reduced price list, thus keeping abreast of the times. Its lamps have now reached that stage of perfection that it feels justified in maintaining that their quality is equal to the standing of the old Beacon lamp.

THE COLUMBIA LAMP COMPANY, St. Louis, Mo., has reduced the price of its lamps to meet the cut of the General Electric Company, and states that the same high grade of the Columbia lamp will be maintained. It says that it is enabled to make this reduction by reason of the magnificent support which has been given to it by users of incandescent lamps throughout the United States during the past year, which has enabled it to largely increase its manufacturing facilities and add additional machinery, which has reduced the cost.

THE STAR ELECTRIC LAMP COMPANY, 102 Michigan avenue, Chicago, brought out about Nov. 1, its new Sunbeam incandescent lamp, with luminous vapor. It is claimed for this lamp that it is a great improvement over both the vacuum and gas lamps which are now on the market. The luminous vapor prevents absolutely, it is claimed, the drop in candle power, and a clear white light is given out during the entire life of the lamp instead of the yellow light produced by the vacuum lamps after they have been running a few hundred hours.

WILEY & PHELPS, of the Monadnock, Chicago, have been fortunate enough to secure the agncy of the De Laval steam turbine, the rotary engine which created so much talk at the late World's Fair. It was in continuous operation in Machinery Hall and its running attracted wide attention. It is the invention of the famous scientist, Dr. De Laval, of Stockholm, Sweden, and has met with great success abroad. Phelps & Wiley are now prepared to supply this very ingenious machine to the American market, and anticipate a most cordial reception among electricians.

"ACME" PORTABLE TESTING SET.—Queen & Co., incorporated, Philadelphia, are making a renewed push of their "Acme" portable testing set, which was temporarily withdrawn from the market because of certain small defects, which have now been overcome in a thoroughly satisfactory manner. After a careful test the United States Government has informed the makers that the set will be accepted for service on shipboard in the navy, where the requirements are extremely exacting. In addition to this a World's Fair diploma was awarded Queen & Co. for "testing sets and standard resistances."

M. T. DAVIDSON, the prominent steam pump builder, of Brooklyn, N. Y., is one of the few manufacturers who starts on the new

year full of business. The works at 43-53 Keap street are running the regular ten hours a day with a full force of men, and at no time during the past year has the dull times made any change necessary or desirable. The outlook for the year 1894 is very promising. The export sales of the Davidson pump have been of late worthy of remark, and a number of important orders have also been placed in the United States. We notice a recent contract awarded to Mr. Davidson for two additional pumping engines at the city pumping station, Fall River, Mass. There are already two Davidson engines in use at these works.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, of 440 Monadnock Block, Chicago, anticipating the expiration of the last Bell telephone patent, which affects their apparatus, already has orders for several thousand telephones, including a number of telephone exchanges throughout Wisconsin, Iowa and Minnesota. Work will be commenced in every instance after February 1, 1894, the date of expiration of the patent. This company has exclusive territorial rights in several States for nearly one hundred of the most valuable patents ever issued, including some of the newest and most valuable telephonic service. It proposes to install nothing but the very best apparatus, and expects that its prestige, already secured, together with the excellent systems which it proposes to equip, will give it a great advantage over smaller concerns which expect to enter into the telephone business.

THE METROPOLITAN ELECTRIC COMPANY, of Chicago, has been fortunate enough to secure the services of Mr. J. J. Nate, who for the past ten years has been closely identified with the Chicago Telephone Company. The first six years of his work there was confined to the practical and construction part of the business. He arose in the company through the successive stages of foreman, manager, superintendent and finally purchasing agent. This experience gave him a thorough knowledge both of the practical and commercial departments of the telephone business, and will be of great service in his present connection, as the Metropolitan Company will do a large business in handling telephones and telephone supplies after the expiration of the patents. Mr. Nate is thoroughly posted on electrical matters in general, having attended the various electric light and street railway conventions, and having maintained a close relationship with the prominent figures in the industry. He resigned from the telephone company, where his services were highly valued, because of his more favorable offer from the Metropolitan, and has received a great many letters of congratulations and good wishes on the change he has made.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has issued its No. 6 catalogue, being the latest edition of its complete catalogue of electrical supplies. The book is bound in heavy purple "Princess" covers, with lettering on two sides and back, in fire bronze, while the title page bears, in red, The Electrical Appliance Company's well-known triangle trademark. The catalogue contains no less than 350 pages, six by nine inches. The first pages are devoted to Packard lamps and incandescent supplies and fittings, followed by arc light and station supplies. A complete and well illustrated list of construction and general tools comes next, after which is a carefully selected list of construction material, including Paranite and O. K. wire. Interior conduit material and test instruments receive the next attention, and a full line of Meston motors closes the electric light department of the catalogue. The remaining 100 pages are devoted to electrical house goods, telephone and telegraph supplies and fire alarm and district telegraph material. The book is very completely indexed, there being an alphabetical index of contents, and an index to trade numbers, as well as one of code words. The entire catalogue leaves nothing to be desired, looking at it from any standpoint.

THE GREAT WESTERN MANUFACTURING COMPANY is the title of one of the most thrifty enterprises in Duluth, Minn., if not in the West. T. B. Casey is president, R. S. Munger, J. S. Young, of Maine, and O. H. Simonds, first, second and third vice-presidents; E. R. Gilman, general manager, and H. A. Odell, secretary and treasurer. J. B. Boyd, an old and favorably known resident of Duluth, is manager of the factory, and Foree Bain is electrical and mechanical engineer in chief. The general offices of the company are located in Chicago, with branch offices in St. Louis, Denver and Pittsburg. The Great Western manufactures everything electrical. It, however, makes a specialty of manufacturing and exploiting the electric lighting and power systems, the inventions of its engineer in chief, known as the Bain systems. They consist of dynamos for local incandescent lighting and for long distance lighting; and dynamos and motors for the transmission of power. The company has a large department in which it produces high class gas and electric fixtures, and all kinds of switches, cut outs and appurtenances for dynamos, meters, rheostats, sockets and shades. It has a large and well equipped factory for insulating electric wire for its own use, besides furnishing quantities for the market. It will add a wire drawing mill in the spring. The company makes its own brass and iron castings, and produces every item of its manufacture necessary for the installation of an electric plant of any magnitude. The plant is large and well adapted to the work and is equipped with the latest and most improved machinery. It employs now about 150 men and is working every night until 11 o'clock. Within the next six months it is thought that the number of employes will be increased to 500.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED DEC. 26, 1893.*

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

511,328.. METHOD OF ELECTRIC COMMUTATION AND FLUID ELECTRIC COMMUTATION; C. E. Emery, Brooklyn, N. Y. Application filed Dec. 28, 1892. The combination of a commutator and a brush formed of circulating conducting fluid.

511,342. CONDUIT RAILWAY TROLLEY; J. C. Love, Chicago, Ill. Application filed May 17, 1892. This comprises a grooved contact shoe, supported by a main arm adapted to swing in a vertical plane, and consisting of two parts, connected by a transversely arranged pivot adapted to allow lateral oscillatory movement in the outer end of the arm, a horizontally arranged arm pivoted to the other end of the main arm and adapted to swing in a vertical plane and to which the shoe is connected by a vertical pivot, and springs yieldingly sustaining the main and horizontal arms.

511,343. TROLLEY FOR CONDUIT RAILWAYS; J. C. Love, Chicago, Ill. Application filed May 17, 1892. The combination of a horizontal laterally moving carrying bar having sliding connections at both ends with the car, of two oscillating notched retainers adapted to engage the ends of the carrying bar.

511,344. SUPPORT FOR ELECTRICAL CONDUCTORS; J. C. Love, Philadelphia, Pa. Application filed Jan. 21, 1893. This comprises two gripping plates having jaws which engage the conductor, and a support for the plates consisting of a two-part socketed clamp, and insulating material surrounding the plates within the socket of the clamp.

511,345. TENSION DEVICE FOR ELECTRICAL CONDUCTORS; J. C. Love, Philadelphia, Pa. Application filed Jan. 21, 1893. This comprises a sliding block and abutment, a spring applied between the sliding block and the abutment, a clip supporting the conductor, and an adjustable coupling rod connecting the clip with the block.

511,346. TROLLEY BAR CARRIER FOR CARS; J. C. Love, Philadelphia, Pa. Application filed Jan. 21, 1893. The combination of a trolley bar carrier capable of lateral movement at both ends, and means for automatically confining the advance end of the carrier when the direction of movement of the car is reversed.

511,347. GOVERNOR FOR ELECTRIC MOTORS; J. Marty, Jr., Cleveland, Ohio. Application filed Oct. 10, 1892. This consists of an armature having its bars diagonal to the axis, and the commutator brushes, mounted diagonally to the axis in a frame adapted to be moved longitudinally back and forth, according as the speed of the dynamo is increased or diminished.

511,358. TELEPHONE; B. Pickering, Dayton, Ohio. Application filed Jan. 29, 1891. In a combined telephone and michrophone, having but a single vibrating diaphragm, a bonnet wire coil as a bearing for the under edge of the diaphragm.

511,375. METHOD OF AND MEANS FOR COMPOUNDING DYNAMO-ELECTRIC MACHINES; E. Thomson, Swampscott, Mass. Application filed Nov. 23, 1892. A dynamo having near each of its field magnet poles a "dead pole."

511,376. ELECTRIC MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. Application filed March 2, 1893. The combination of an oscillating horseshoe magnet having its poles closely approximated with a coil having a fan-shaped winding upon a conducting bobbin extending between the poles of the magnet.

511,401. ELECTRIC METERS; L. Brillie, Paris, France. Application filed Nov. 22, 1893. An electric meter having a dynamometer serving to control the speed of an electric motor exerting an opposite tendency on the dynamometer through the medium of a magnetic retarder, with a metal cylinder connected to the other and a plurality of U-shaped magnets, with their poles projecting on opposite sides of the cylinder, and connected to the other part.

*Owing to an unavoidable accident, it was found necessary to omit patent illustrations this week.

511,407. PROCESS OF MAKING RESISTANCE PLATES; C. E. Carpenter, Bridgeport, Conn. Application filed Feb. 7, 1893. This consists in attaching a coating of enamel to a support, shaping a conductor into curved or reflex form, placing the conductor upon the surface of the coating, covering this with a coating of enamel having a lower fusing point than the enamel already applied, and raising the whole temperature sufficient to fuse the second layer.

511,419. TROLLEY WIRE CROSSING; H. Geise, Philadelphia, Pa. Application filed June 26, 1893. The combination of wires insulated at the point of crossing each other at a point above the normal level of the wires, and a travel plate provided below the point of crossing, upon which the trolley wheels are adapted to run.

511,434. GALVANIC BATTERY; H. T. Johnson, New York, N. Y. Application filed April 21, 1893. In a dry battery the combination of a containing cup forming the positive electrode, a semi-solid filling within the same, and a negative electrode having an uneven surface embedded in the filling.

511,448. ELECTRIC LOCOMOTIVE; J. G. McCormick, Louisville, Ky. Application filed April 1, 1892. This comprises an electric motor mounted on the axle, a bar for preventing the rotation of the field of the motor, and arms secured at one end to the bar and at their other ends made to embrace the casing of the motor.

511,451. ELECTRIC BELL; A. J. Oehring, Chicago, Ill. Application filed April 25, 1891. A bell having magnets and cores of oblong cross section, the magnets occupying positions with their greatest diameters parallel, and an armature pivoted to the axis at right angles to the greatest dimensions of the magnets.

511,452. CONDUIT ELECTRIC RAILWAY; H. D. Oler, Paterson, N. J. Application filed Aug. 23, 1892. A conduit having wooden blocks fastened therein, the blocks having grooves formed in them in which a conductor is held, sliding blocks in the groove, plates hinged in the conduit and connected with the blocks and a wheel passing through the conduit slot to act upon the hinged plates.

511,456. TELEPHONIC INSTRUMENT; P. Rabbidge, Sydney, New South Wales. Application filed April 22, 1893. A receiver case, diaphragm, magnet and spring armature, the spring armature being distinct from the diaphragm and inclosed within the case, in combination with a gravity switch for cutting out the alarm circuit when the receiver is held to the ear.

511,459. CARBONIZING APPARATUS; I. L. Roberts, Brooklyn, N. Y. Application filed Dec. 8, 1892. A perforated electrically conductive vessel and an outer non-conductive covering.

511,461. SAFETY DEVICE FOR ELECTRIC CIRCUITS; C. H. Rudd, Evanston, Ill. Application filed Dec. 10, 1888. This comprises a shunt circuit around the working circuit, the shunt circuit containing high ohmic resistance, and a central connection to the ground from the shunt circuit.

511,462. FIRE-ALARM TELEGRAPH; S. H. Rudd, Chicago, Ill. Application filed May 19, 1892. This comprises two magnetic helices adapted to operate in opposition to each other upon an armature, heat responsive devices adapted to open the circuit when actuated, and mechanism controlled by the armature for sending the alarm signal.

511,464. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. Application filed April 26, 1893. A system of circuits such that the signal receiving annunciator of any line while connected with the line circuit is irresponsive to signaling currents in the circuit during the connection of the line with another telephone line.

511,495. ELECTRIC ARC LAMP; R. Belfield, London, England. Application filed April 5, 1893. This comprises a feeding mechanism carrying an actuating stem, a core loosely sleeved thereon, an abutment for the core at one end of the stem and a solenoid for raising the core.

511,503. ELECTRIC MEASURING APPARATUS; T. Bruger, Bockenheim, Germany. Application filed Aug. 19, 1893. This comprises a stationary polarized solenoid and a double solenoid of alternate positive and negative poles, the double solenoid being mounted coaxially with the stationary solenoid and adapted to move over the same.

511,512. MACHINE FOR SEPARATING MAGNETIC FROM NON-MAGNETIC SUBSTANCES; C. G. Crosby, New York, N. Y. Application filed Jan. 11, 1893. The combination with a carrier and the electro-magnetic wheel of a feeder comprising a chute having steps, and adjustible vertically and horizontally relatively to the wheel.

511,514. PROCESS OF AND COMPOSITION FOR THE MANUFACTURE OF POROUS CUPS FOR ELECTRICAL BATTERIES; F. G. Curtis, Philadelphia, Pa. Application filed Feb. 13, 1893. This consists of moistening clay with a solution of carbonate of ammonia and carbonate of potassium in molding the moistened clay and then baking the same.

511,523. CURRENT REGULATOR FOR DYNAMO-ELECTRIC MACHINES; C. D. Haskins, Brooklyn, N. Y. Application filed Nov. 12, 1892. This comprises a magnetic field whose strength varies with the strength of the generated current and an independently mounted rotatable armature adapted to shift the position of the brushes upon the commutator to maintain a constant current in the working circuit.

511,524. CONVERTER SYSTEM FOR ELECTRIC RAILWAYS; G. E. Hese, Brooklyn, N. Y. Application filed Nov. 21, 1892. A rail for an electromagnetic railway having branches wound with an insulated electric conductor for utilizing the rail as a primary magnet.

511,547. ELECTRIC WIRE COVERING; F. S. Randall, Philadelphia, Pa. Application filed June 2, 1893. A covering consisting of raw cotton in bulk.

511,559. ELECTRICAL TRANSMISSION OF POWER; N. Tesla, New York, N. Y. Application filed Dec. 8, 1888. A method of operating motors having independent energizing circuits, consisting of passing alternating currents through both the circuits and retarding the phases of the current in one circuit to a greater or less extent than in the other.

511,560. SYSTEM OF ELECTRICAL POWER TRANSMISSION; N. Tesla, New York, N. Y. Application filed Dec. 8, 1888. The combination of an alternating current dynamo with a motor having independent energizing circuits connected in multiple arc with the circuit and of different active resistance.

511,570. ROTARY ELECTRO-MAGNETIC MACHINE; H. P. White, Kalamazoo, Mich. Application filed Feb. 15, 1893. The combination of a multipolar armature magnet and coils, with a number of circular-head hollow wedges of magnetic material interposed between the adjoining coils of the armature.

511,574. ELECTRIC TRANSFORMER; J. J. Wood, Fort Wayne, Ind. Application filed May 19, 1893. An iron-clad transformer punching, having limbs of unequal length, with its middle, or core limb, formed in a reverse curve, longer on one side of its middle than on the other.

511,589. TELEPHONE SYSTEM; F. R. Colvin, New York, N. Y. Application filed June 26, 1893. A telephone system having an independent wire for each station, normally open circuit closers at each station connecting with the individual wires of the other stations, and a generator and telephone adapted to be put into circuit with any of the individual lines by mere engagement of the contacts.

511,599. PATROL BOX; W. Eglin, Philadelphia, Pa. Application filed Jan. 19, 1892. A patrol box having a signal, with a rising and falling rod carrying a weight, an armature engaging with the weight, and means for breaking the circuit by the movement of the door of the box.

511,611. INSULATOR; C. N. Hammond, Boston, Mass. Application filed Sept. 1, 1892. An insulator having a recess to receive the wire, lips or projections, and a slot leading to the recess, the wall on one side being cut away to form a retaining point.

511,612. INSULATOR; C. N. Hammond, Boston, Mass. Application filed April 12, 1893. An insulator having openings to receive the wire, the openings being curved and having an overhang on one side.

511,613. ROSETTE FOR ELECTRIC LIGHTS. C. N. Hammond, Boston, Mass. Application filed June 30, 1893. A rosette having at its opposite sides flanges or ears provided with projections, serving as binders for the feed wires, and also having guides for the lamp cord strands adapted to apply the strands directly to the feed wires at the points protected by the ears.

511,621. ELECTRIC MOTOR APPARATUS; W. A. Johnston, A. W. Browne and J. C. Davidson, Prince's Bay, N. Y. Application filed April 25, 1893. A box for a foot actuated motor switch mechanism provided with locking mechanism for holding them nected heel rest for the foot.

511,627. ELECTRIC RAILWAY SWITCHING MECHANISM; C. J. Kintner, New York. Application filed June 24, 1893. This comprises an insulated main, a series of pivotal sectional trolley conductors provided with locking mechanism for holding them in electrical contact with the current main.

511,647. ELECTRIC GRAIN WEIGHING SCALE; J. and D. De P. A. Outcalt, Spotswood, N. J. Application filed July 8, 1893. A weighing apparatus having separate aligned solenoids with a single intermediate core, a cut off attached to the solenoids' core, and means for automatically energizing the solenoids separately.

511,720. FIRE GUARD FOR LAMP CORDS; E. E. Angell, Somerville, and S. Porter, Boston, Mass. Application filed April 20, 1893. A fire guard, comprising two connected discs, each provided with slots for receiving the strands of the lamp-cord, the discs being adapted to turn on each other to close their slots.

511,731. ELECTRIC SIGNALING APPARATUS; T. B. Doolittle, Bridgeport, Conn. Application filed Feb. 13, 1893. A visual annunciator consisting of a magnet and a rolling indicating armature confined and guided in a casing having an aperture at which the indicating armature is displayed.

511,739. TELEPHONE SYSTEM; J. J. McNally, California, Mo. Application filed Aug. 31, 1893. The combination of separate line circuits normally open and an electromagnetic step-by-step mechanism at the central office, whereby when the switch of a subscriber is closed the step-by-step mechanism will automatically close the circuit with the subscriber desired.

511,742. ELECTRIC CAUTERY APPARATUS; J. A. Wotton and E. A. Bostrom, Atlanta, Ga. Application filed June 26, 1893. This comprises primary and secondary coils, a transformer movable to and from the same, a rack secured to the movable coil, a pinion mounted on the shaft set in the casing, and a handwheel thereon outside of the casing.